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ABSTRACT

This study guide for environmental education focuses on development of knowledge and attitudes concerning environmental factors and inter-relationships. The activities designed for use in elementary and intermediate grades begin in the classroom and move outside to the schoolyard, the town, and natural or rural areas. Three units dealing with environmental awareness, the urban ecosystem, and nature's ecosystem are detailed. Appendices include a vocabulary list and bibliographies of related reading materials. (SHM)

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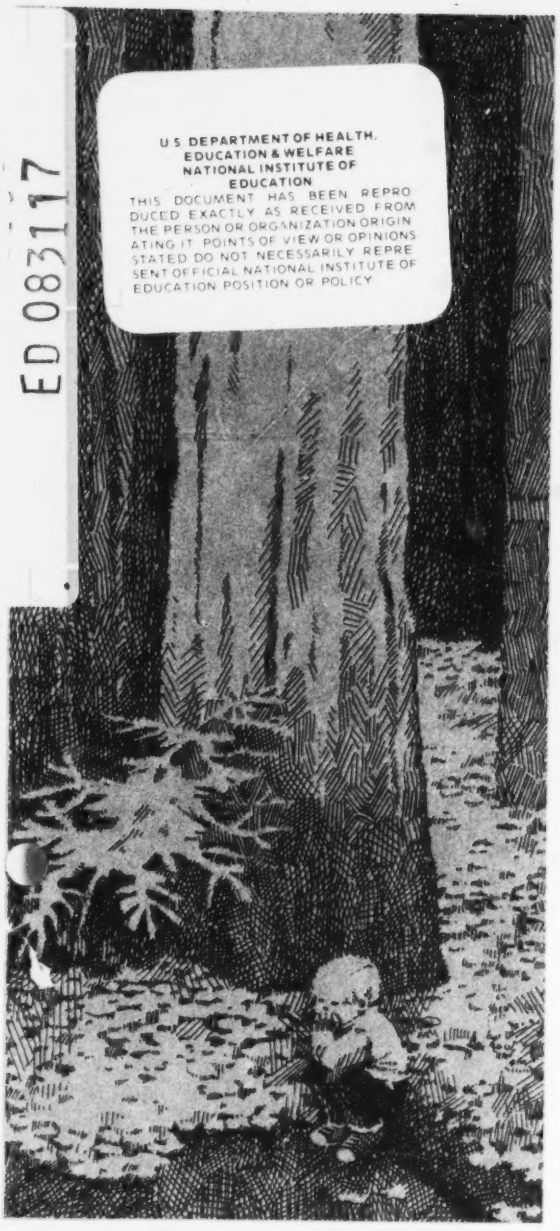

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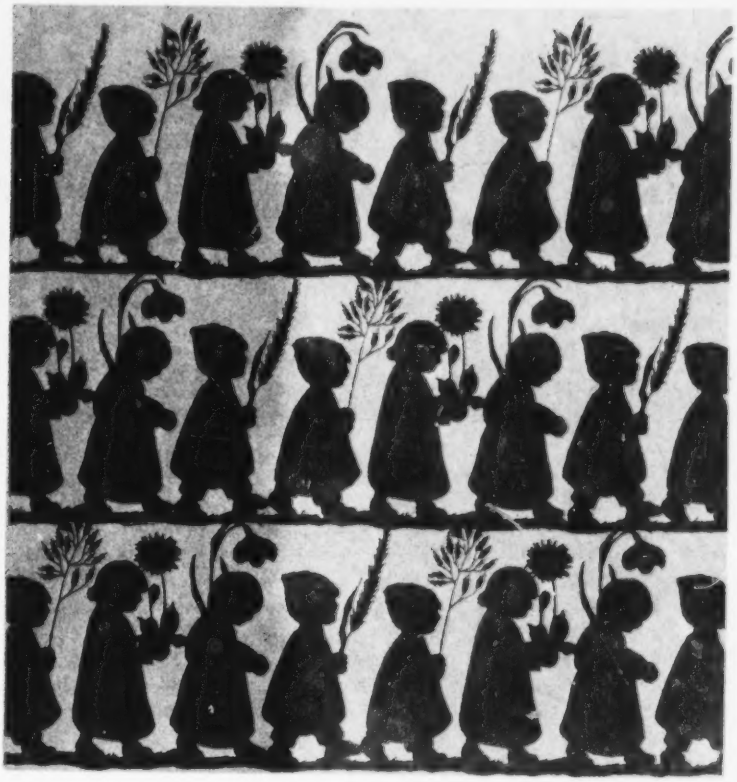

all around you

AN ENVIRONMENTAL STUDY GUIDE

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United States Department of the Interior
Bureau of Land Management

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
25TH ANNIVERSARY 1971

IN REPLY REFER TO:

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BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240
March 1973

TO TEACHERS AND STUDENTS:

We in the Bureau of Land Management are heartened by the mounting concern and leadership which both students and their teachers have been demonstrating with regard to the protection and thoughtful development of our nation's lands and resources. All educational institutions can perform a valuable service by imparting, both to young people and to adults, knowledge and attitudes which will enable all of us to work together to improve the quality of life in this country.

The environmental education materials in this booklet were developed for BLM during Summer 1970 by six young people, schooled in physical sciences, social sciences, and education—and concerned about the future of our environment. The materials were prepared with students at the late elementary and junior high school grade levels in mind, but you will probably find many of the lesson suggestions appropriate for use or adaptation at all grade levels. We hope these ideas will help you develop an awareness—an understanding—for your own surroundings. Given the tools for discovery, we believe students can learn more about, and develop greater responsibility toward, the world about them.

All BLM lands can be used as a living laboratory for the study of land and resource management and protection. We urge students and teachers to use the public lands as outdoor classrooms. We hope you will call on our State and District Office staffs for assistance with your environmental education activities.

Sincerely yours,

Director

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
25TH ANNIVERSARY 1971

FOREWORD

To The Teacher:

People everywhere are becoming concerned about the solution of environmental problems, and about the protection and wise use of our natural resources. We all want to understand more about environmental factors and inter-relationships, and we would like our young people to learn more and to become concerned about our environment so that they can appreciate and use it with greater care in the future.

Although environmental education is based upon ecology–the science of the inter-relatedness of all living organisms in their environment–environmental education also encompasses ideas from all the traditional school subjects. The objective of environmental education is not the mastery of isolated facts and routine skills. Rather the objectives are an understanding of basic environmental inter-relationships and problems, the development of investigative and problem-solving skills, and individual motivation to help solve environmental problems.

Since the objectives of environmental education are so relevant to our personal interaction with our environment every day, we hope that ideas from environmental education can be woven into the daily classroom schedule so that they can somehow tie our classroom experiences more closely to our own lives. The student will understand best those things and inter-relationships around him that he explores and discovers for himself; he may see how each thing relates in some way to his life. You can offer every student the opportunity to use his natural learning ability, at his own speed, to investigate inter-relationships and ideas that interest him and are important at the same time. Positive motivation and feelings of self-accomplishment should result.

There is no need to use the sections and questions in this book in the order that they appear. Throughout the year you will probably want to use the separate pages freely, in accordance with your students' interests, their learning levels, and the regular school subjects you want to teach. We believe the questions and ideas in this book will stimulate each student to pursue interests and new ideas on his own. As you see these interests growing, you can share his enthusiasm and guide his learning at appropriate moments.

You may ask: "How can I answer my students' questions?" No one can learn everything about Nature and ecological relationships overnight. The Teacher's Pages will introduce you to the world of ecology and set you to exploring right along with your students. We hope the perspectives provided by the Teacher's Pages will enable you to help your students find some answers to their questions–through practical investigation, through laboratory and library research, and through talking with knowledgeable people. The Teacher's Pages will follow an alphabetical letter sequence so that you can remove them from this book without disturbing the Arabic numeral sequences of the pages designed for the students.

The activities in "All Around You" begin in the classroom and move outside to the schoolyard, the town, and natural or rural areas. All of these places offer good opportunities for environmental study. You and your class may wish to visit the public lands, where a variety of resource utilization and conservation programs are underway. If you are interested, the personnel at your nearest BLM office, or at other resource management agencies, can help you determine what areas are available and most suitable for your purpose, and suggest some of the learning opportunities these areas present. If you visit the area and become familiar with its history, its physical features, its usage, and unique environmental relationships or problems before you take your class, the success and enjoyment all of you derive from your outdoor experience will measurably increase.

If you already have a favorite place or area you are familiar with which you think will help your students better understand environmental relationships, by all means use it. We hope you will enjoy getting to know your environment better!

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Teacher's Page

No matter where we come from, each of us carries at least a few vivid impressions from our childhood and youth. Many of these memories involve our relations with family and friends. We can also recall some very pleasant and meaningful experiences which acquainted us better with the world around us. One of us remembers the quiet, dewy mornings, the birds chirping as the sun streamed in the bedroom window; another remembers that first real adventure in the forest, a mixture of freedom, fear, and awesome wonder; a third recalls the friendly human interchange, the bustle and confusion, the slender shafts of sunlight in the morning on a skyscraper-lined city street.

What do you like to remember most? And now, what experiences does your environment offer which bring stimulation or a feeling of contentment? A soothing, rippling woodland brook? The fresh breeze in the open country? The laughter and chatter of happy people in a cool green city park? The warmth and cheeriness of your neighborhood, or another neighborhood in town? What parts of your environment make you feel the happiest?

In every part of the country, the pace of our lives is increasing. We need to stand still for a moment and enjoy these experiences which enrich our lives. Today, as people realize how important their environment is to them, they are becoming more concerned to protect the quality of the environment and improve it. This requires more than an appreciation of one's surroundings; it requires some understanding of the inter-relationships among all parts of the biological community, including Man. Scientific experts are at work on many of our environmental problems, but we can't begin to solve these problems unless every individual places value on a healthy environment and is motivated to help as much as he can. If you are concerned, encourage others to become more sensitive to their environment, and to learn more about preserving and creating healthful environments to live in.

SECTION I

Awareness:

Your Environment Is All Around You

HAVE YOU THANKED A GREEN PLANT TODAY?

Did you see a green plant?

Did you see the grass growing in the sidewalk cracks?

Did you see the dandelion growing in the street next to the curb?

What things have you seen today? Do you remember anything about them? What were their colors? Did they make any noise? How did they smell, and taste?

Let's explore!

YOUR ENVIRONMENT IS ALL AROUND YOU!

The exploration of your environment will begin here, wherever you are right now, which is probably in the classroom. To explore, use your senses!

SEEING
FEELING
SMELLING
HEARING
TASTING

These are the tools you will use; they are all you need.

If you are like most people, your senses may need a little tuning up. Today in our machine-age cities, people rely less and less on their senses and more and more on machines for information about the world around them. They can go through life looking without ever seeing, touching without ever feeling, and listening without ever hearing. It is an easy, but dull existence.

Developing greater sensitivity can be fun. By using your senses to their fullest, you will become more aware of both yourself and your surroundings — in other words, of your environment.

Start with the big blob of things you can see out the classroom window. Everything in the world is different and everything means something different to every person. Differences can be in color, texture, shape, smell or any other quality. Even though things are different there still are many ways in which they are alike.

What sort of things do you see out the window? Take some time and don't just look; try to really SEE!

Things I see:

You have used your eyes to notice some things outside the window. This is only a beginning. Your eyes can tell you more than just what objects are present. They can show you how things are alike, different, and how they are related. Let's investigate some of these relationships.

Are some of these things alike in some way? How are they alike? For example, are they the same color? size? texture?

Teacher's Page

Our environment is a constantly changing dynamic system. Like the movement of a clock's hour hand, change may be imperceptible, but it is constantly occurring. Buildings are crumbling, mountains are being born, and people are growing older. Any interaction between two members or factors in the environment produces a change—even if you and I are not here long enough to see it happen.

If you take a leisurely walk in your neighborhood or another neighborhood in town, you will see many changes taking place. Some are for the better; they improve people's lives. Other changes are the result of man's neglect or misuse of resources. To accomplish change, people must pool their efforts and, in some cases, their funds.

In a world that is changing so rapidly, we need a better understanding of the kinds of change that will benefit man. Because the needs and interests of individuals vary, they will not always agree that specific changes should be made. But if the conditions and changes which make for a healthy, balanced environment can be identified, these should become our common goal. Scientists must investigate some of these changes. However, we can use our own common sense to recognize basic changes needed, such as cleaner water. We can express our personal preferences concerning the kind of community that we think would be healthy and pleasant to live in. Working together, we can bring about many important changes ourselves.

In what other ways might these things be alike? Think about what they do in your environment. What is their function?

In what ways are the things you have listed different?

Are any of these things changing in any way? If they are, how? What is causing these changes?

What is changing?	How is it changing?	Cause of change?

Are there any objects on your list that look as though they aren't changing? If there are, how do you think they will look in 10 years? 100 years? 1,000 years?

Objects	10 years	100 years	1,000 years

From your list pick out your favorite thing . . .

Use one word to name what it is.
Can you use two words to describe it?
Three words about what it is doing?
Four words to describe how you feel about it?
One word which, to you, means the same as the first word?

For Example:

walls

big small

fences stop dividers

keeps one from another

tall*

Your Favorite Thing:

_____

_____ _____

_____ _____ _____

_____ _____ _____ _____

_____

You just wrote a poem called cinquain (sin-kane) about your favorite thing which you saw from the window.

Is there anything you saw from the window which you didn't like? What are some of the things you didn't like? Why not?

Write a cinquain about a thing you saw which you did not like. Compare it to the first cinquain you wrote.

_____

_____ _____

_____ _____ _____

_____ _____ _____ _____ _____

_____

* adapted from a cinquain by Mary: Charline McDonald; "A Place I Like," Washington Education, Washington Education Association, March 1970

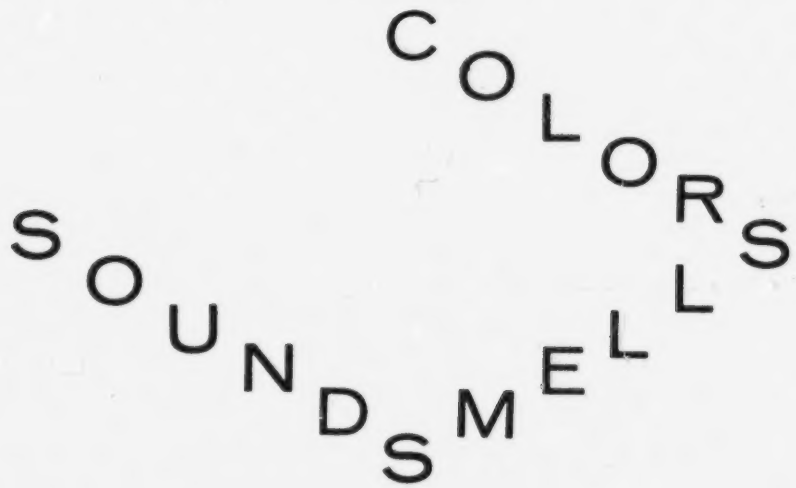
If you could change some of the things you saw which you didn't like very well, what would you do to them and how would you go about doing it? Would your changes result in other changes or side effects?

Changes I Would Make	Possible Side Effects

When we try to pick out anything by itself, we find it hitched to everything else in the universe.

–John Muir

Teacher's Page



Colors, smells, and sounds are an exciting part of anyone's environment. They add a great deal of enjoyment to our lives if we remember often to notice them. They tell us what season it is, whether other living beings are far away or nearby, and what the condition of our environment is.

Can you imagine a world without colors? Without smells? Without sounds? In that kind of world, the thoughts and ideas you could conceive and express would be severely limited. Our ways of communicating with other people would be markedly reduced.

Colors, sounds, and smells seem to have very definite effects on the way we feel, and even on the way we act. Each individual uses colors, odors, and sounds to identify other people and to develop his own self-image.

Colors, smells, and sounds in Nature offer great diversity and beauty to what might otherwise be a very dull scene, and many of them can not be reproduced by Man. On the other hand, think of the unique colors and sounds man has produced through technology, and especially through music, the visual arts, and literature. There are even some man-made odors we really like, such as fresh-perked coffee, or home-baked bread!

Colors

Like acrobats on a high trapeze
The Colors pose and bend their knees,
Twist and turn and leap and blend
Into shapes and feelings without end.*

Notice the colors of the things on your list which you didn't like very well. Compare these to the colors of the things you did like. Is there any difference? If so, what is the difference?

What is your favorite color? _____ . How does that color feel? How does it taste? How does it smell? How does it sound?

feel _____
taste _____
smell _____
sound _____

List the things you observed from the window which are your favorite color.

Things My Favorite Color:

1.
2.
3.
4.
5.

Let's go outside and take a closer look at what you have been observing and thinking about!

Take a good look at the natural objects around you. What colors are present in the natural objects you can see?

Natural Objects	Colors Present
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.

*From HAILSTONES AND HALIBUT BONES, by Mary O'Neill. Copyright © 1961 by Mary Le Duc O'Neill. Reprinted by permission of Doubleday and Company, Inc.

Compare these colors to the colors of the man-made objects, including clothing, you see. Where is the greatest variety found, in Man or Nature?

Where is your favorite color found most often, in man-made objects or in natural objects?_____ . What purpose does the color serve in these objects?

What colors are the animals and birds that you see or have seen? What do these colors do for the animal or birds? Can you think of how colors help animals or birds survive?

Animals/Birds	Color	What the color does

Notice the advertising around you. What colors are present?

What role do colors play in advertising? For example, is a colored sign more interesting than one which is black and white?

Do colors affect and change you and your behavior? How? For example, think about how you would feel in an all-black room. What do colors have to do with your choice of clothing?

The Colors live
Between black and white
In a land that we
Know best by sight.

But knowing best
Isn't everything,
For colors dance
And colors sing,
And colors laugh
And colors cry –
Turn off the light
And colors die,

And they make you feel
Every feeling there is
From the grumpiest grump
To the fizziest fizz.

And you and you and I
Know well
Each has a taste
And each has a smell
And each has a wonderful
Story to tell. *

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Smells

We have a habit of not using our senses to their capacity. The sense of smell is one we probably ignore the most. This is unfortunate since smells can tell you a lot about your surroundings.

Stop for a minute and use only your nose. Breathe deeply and take notice of everything your nose senses. List the different smells you can pick out. Where do they come from?

Smells	Where they come from

Are some smells more pleasant than others? _____ . Which ones are they? Why do you like them better?

How often do you rely on your sense of smell? Think about what your sense of smell does for you in your everyday life. Give some examples of how you use your sense of smell.

Examples:

Would it be possible to develop your sense of smell so that it could do more for you? If you think it would be, how would you do it?

Imagine that you are living in a forested area in North America about 400 years ago and that for your survival you depend on deer hunting. How important a role would your sense of smell play in your survival? Why?

Does this tell you anything about why your sense of smell isn't very acute? What?

Describe how it smells outside when the first rain is just beginning to fall after a dry period. Use a cinquain, sketch, story or anything else to make this description.

Sounds

The sound of black is
"Boom! Boom! Boom!"
Echoing in
An empty room. *

Sounds are an exciting way to learn more about your surroundings. They can tell us a lot when we are aware of them, of where they come from, and of what they mean.

Listen for a moment . . . what sounds do you hear? What is the source of each sound?

Sound	Source

How are these sounds similar? How are they different?

For example:

some are soft, some are loud

Are some sounds more pleasant than others? Which ones are they and why do you like them better?

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Stop and listen at different times during the day. Do you hear different sounds at certain times in the day? Where are they coming from? Why do you hear some sounds at one time during the day and not at another?

Are there any sounds that never stop? What are they? If they never stop, why don't you hear them all the time?

Listen again. What is the smallest sound you hear? Try describing this sound with a cinquain as you did earlier with your favorite thing.

_____

_____ _____

_____ _____ _____

_____ _____ _____ _____

_____

The tiniest sound in the world
is a snowflake
as it
falls
from
the
sky
and
gently
turns
into
a
tear.

Can you imagine what the tiniest sounds in the world are? Describe what you think the tiniest sound is, using a sketch, a poem, or anything else you wish.

YOUR SENSES: USING THEM ALL AT ONCE

What is your very favorite place in the world? _____ . Describe it using all of your senses, trying this method for a start:

Use one word for color _____
Use two words for how the place feels _____
Use three words for how it sounds _____
Use two words for how it smells _____
Use one word for how it tastes _____

Make up your own ways of describing your favorite place. Use words, sketches, anything you wish. See if some of your classmates can figure out what your favorite place is just by looking at your description of it.

I like this place because it is up high and it is comfortable. Across the street there is a big pipe. It makes a noise that sounds like music.*

*from: Charline McDonald "A Place I Like," Washington Education, Washington Education Association, March 1970.

COMPARING

You have done some work both inside and outside.

Did the things you observed from inside the classroom seem different when you looked at them outside? How were they different and why?

Are things more interesting to you when you can use more of your senses to find out about them? Why?

"I discovered the secret of
the sea in meditation upon a
dewdrop."

—Kahlil Gibran

You have completed some activities designed to help you see and understand the world around you. This is only a start; there is much more you can do on your own. Developing your senses takes time and some work, but it is worth it! What you will do on your own is even more important to you than what you have already done. As you continue with this guide, use your imagination and most of all your senses.

SECTION II

The Urban Ecosystem

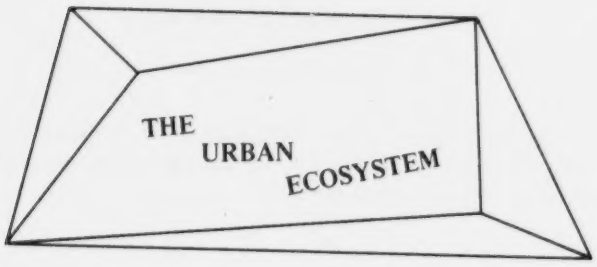
Teacher's Page

Long before man arrived, natural ecosystems existed on earth. The inter-relationships of organisms in these ecosystems were very complex, but in the long run they were naturally regulated and balanced. Man introduced the urban settlement and gradually developed ways to deliver essential commodities from the natural environment to urbanized man.

Man's urban settlements have grown and urban inter-relationships, or urban ecosystems, have become increasingly complex. But no matter how urbanized a man's way of life becomes, he and his neighbors are still part of the intricate natural ecosystem, too. Man depends upon plants and animals, sunshine, water, air, and soil for his life and good health.

Every town has a history of settlement or urbanization. Some towns were founded with a large population in mind; some were not. Similarly, some towns expanded in a rational manner, while others mushroomed overnight. If you are trying to imagine what caused people to "urbanize" or move to your own town, think about some familiar urban settlements in history, such as ancient Greece or Rome. What reasons did these people have for joining together in an urban community? Are some of these reasons still operative today? What problems do you think these ancient communities had in relating to their natural surroundings, and how did they attempt to solve these problems? The urban ecosystem today may be more complex, but it still relates directly to the natural ecosystem surrounding it.

Your path from the urban ecosystem to the natural ecosystem is more direct in some towns than in others. Each urban ecosystem promotes a certain style of life which depends on the town's size, its design, its function(s), its location, and many other factors. How does your town influence your life? You are closely related with many elements in your urban ecosystem. You can influence some of these environmental factors, just as they influence you.



Most of us live in a town. Some towns are small; others are very large. Each town has reasons for being what it is. Some were started because of ranching, others because of logging, others because of transportation. For some reason people came to live in a town. People of all types. People with different backgrounds. People with different goals. People living their lives in different ways.

How do you fit into your town?

How does your town affect your life and the lives of other people in it and around it?

HOW IT GOT HERE AND WHY

Describe or sketch the shape of your town. You may need to refer to maps if you live in a large town or if you haven't seen it all. Maps and an atlas can be a big help for this activity. Describe or sketch your town's shape in a way that a person new in town could understand.

In the sketch or description you made of your town's shape, locate or describe:

1. residential areas
2. major stores
3. main highways
4. railroads and airports
5. large industries
6. schools
7. city or county parks

Why is your town shaped the way it is? As you investigate this question, record the natural and man-made features which cause this shape. Also, look into the history of your town area. What role did people play in influencing the shape of the town?

Man-made features	Natural features

Has your town always been this shape? _____

Make a simple sketch of how you think it looked:

25 years ago:

50 years ago:

100 years ago:

Why do you think this town was started here?

Finding out if you are correct can be fun. Dig into the history books and talk to some of the old-timers in town who probably have some interesting stories to tell about your town's beginning.

Is this the same reason your town exists now? _____
If not, what is the new reason for its existence?

What are some of the advantages and disadvantages to the town's location in relation to its growth? Think about how the town's location would affect it if the population were rapidly increasing, or if the town wanted to make improvements in its facilities and buildings.

Advantages	Disadvantages

What is the average winter temperature for your town or the closest town to you?

What is the average summer temperature? When is it the wettest in your town? When is it the driest?

winter _____ wet _____

summer _____ dry _____

What natural features most affect the climate of your town? Think especially about major land features such as mountains, lakes, etc.

Do you think the climate is a major reason for your town existing where it is now? Why?

How does the climate of your town affect your life? For example, do you need air conditioning in the summer? Do you need extra heavy clothes in the winter?

Teacher's Page

The liveability of a town depends to a great extent upon the way its land area is utilized. Land can be used for many purposes, for example: for people (parks, malls, housing developments, scenic easements, open spaces); for institutions (schools, libraries, museums, prisons); for industry; for transportation (parking lots, wider streets, freeways, airports).

With our rapidly growing population, making proper land use decisions has become increasingly important and also difficult. There are many kinds and levels of land use planning done at different governmental levels. At the local level, many jurisdictions are adopting tools for land use control, such as zoning regulations, flood plain zoning, housing codes, construction codes, use permits, sanitation regulations, and pollution standards. You may also be interested in comprehensive land use planning proposed at the state and national levels; in some states, statewide planning, either comprehensive or for specific purposes, is already underway.

Thinking about your town's present land uses, perhaps you will say, "If only we could start over again!" You could list all the needs of your expected population and, through a process of compromising and balancing needs, design the ideal community. At the same time, you would evaluate the natural resources on your town site to determine the kinds of development that would suit each place best, and to identify those natural resources of aesthetic or environmental value which would require protection. You would establish land use and governmental controls to regulate urban growth from the beginning.

The designers of "new towns" in the United States and other countries are lucky because they can start from the beginning in planning a town (although designing a liveable "new town" is challenging, difficult work!). But "new towns" cannot meet all our people's needs. Those of us who live in old towns need effective land use planning and controls even more. Over a period of time, strong enforcement of these controls can help us preserve our cultural heritage while, at the same time, improving our buildings, our streets, and our open spaces to make life healthier and more pleasant for everyone.

Land Use

Land is a basic resource for all living things. How has the land in and around your town (urban and suburban) been used in the past? How is it being used now? How do you think it will be used in the future?

Sequence of land use in your town area

Land user	Use of the land	Type of settlement	Effects on environment	What residents value in the environment
Past				
Present				
Future				

Look closely at the map you made of your town. How much land is devoted to parks, shopping areas, industrial sites, etc.?

Use	How much

How would you like to see the land in your town area used in the future?

What agencies or offices make the land use decisions that affect your town?

Does your town have zoning laws? _____ If so, what types of zones are there?

List:

Does your town have any serious problems related to land use, such as major erosion, land slides, or floods? Are there provisions in your town's zoning laws to deal with these problems?

Land use problems	Zoning law provisions

Keeping the zoning laws of your town in mind, do you think land uses and the shape of your town might change in time if these laws were modified in some way? Why?

How does your town compare with its nearest neighbor? Think about the land use, climate, natural features, size, etc.

The nearest town is: _____
Comparison:

Teacher's Page

Without people, a town has no reason to exist. These days we are concerned that every town fulfill its purpose: to meet the needs of the people who live there.

People come to towns for many reasons. Some people bring a skill, seeking employment to earn their living. Some seek protection from the outdoors; they want the comforts of an urban home and life style. Some crave the opportunity to meet and learn from other people with backgrounds different from their own. And others seek the companionship of friends, or of an entire community which shares their customs and values. You can easily add more reasons to this list.

A variety of cultural histories and customs in any town lends richness to its character–to its streets and buildings, its celebrations, its political life, and to the moods of the people you see everyday. If we become interested in the life styles, in the pleasures and problems of people with backgrounds different from our own, we make new friends and at the same time grow to understand and appreciate our own lives more.

But as urban populations grow, governmental and other organizational structures must be developed to assure that people's basic needs are met, and that our resources, both natural and man-made, are being used to provide our people the best life possible. In most towns, the needs of some people are not being met. It is important that we recognize and attempt to correct poor living conditions if they exist in our towns. Towns are for <u>all</u> the people!.

YOUR TOWN AND THE PEOPLE WHO LIVE THERE

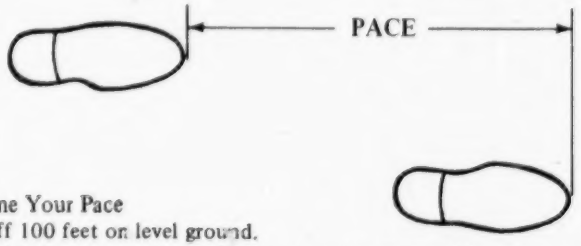
Population is more than just a certain number of residents. It is people, their similarities and their differences, that make population study interesting.

When studying the population and its traits, mapping is a useful tool. Before studying your town's population, spend some time learning how to make maps.

Mapping: A Useful Study Tool

It is important to know where you are! This is one reason people use maps. There are many types of maps for many different purposes. Sometimes it is useful to make your own map for your own purpose.

To make your own map, you must first determine your pace. Your pace is the distance you travel each time you take a step.



How to Determine Your Pace

1. Mark off 100 feet on level ground.
2. Travel the distance marked off in a normal walk. Do this twice, and count your steps each time.
   number of steps taken first time _____
   number of steps taken second time _____
   Total Steps Taken _____

total distance walked	÷	total number of steps taken	=	your pace

Using Your Pace

1. When pacing, be sure to walk in normal easy strides (the same one you just used to determine your pace).
2. Count the number of steps it takes to walk the distance you need to know.
3. Multiply the number of steps taken times your pace.

number of steps taken	x	your pace	=	distance traveled

How far is it from:

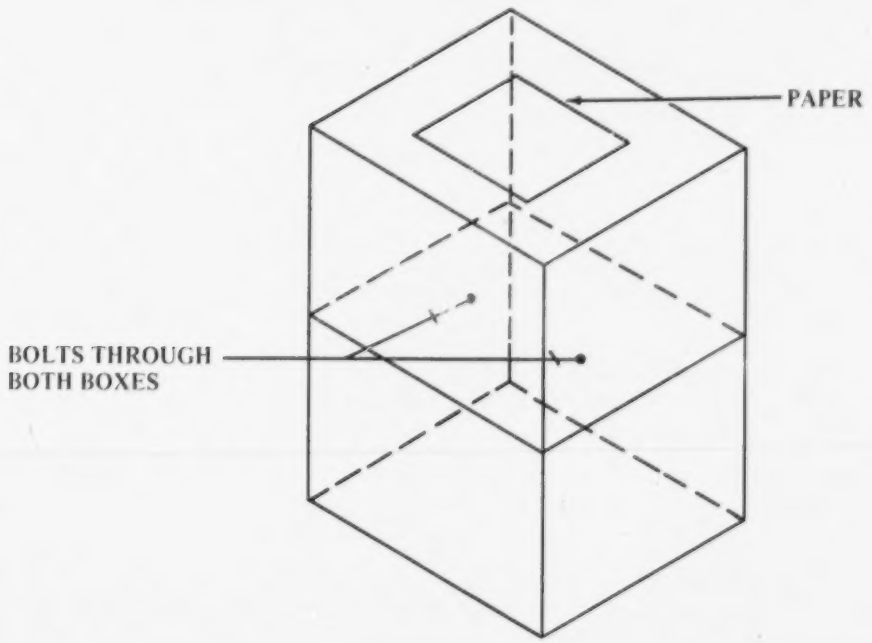
your classroom to the office and back? _____
your classroom to the gym and back? _____
your class room to the bus stop and back? _____
your classroom to the tallest thing in your schoolyard and back? _____

Directions For Making Your Own Map–Materials Needed:
(Try this on your schoolyard.)

2 cardboard cartons, the ends of each having minimum dimensions of 10" x 14"
2 bolts (¼" x 1") with which to fasten the boxes together (or nails)
1 sheet of unlined paper 8" x 10½" minimum
1 wooden 12" ruler
2 tacks or brads, ½" long
cellophane tape or masking tape
pencil
2 stakes, one blue-flagged and one red-flagged

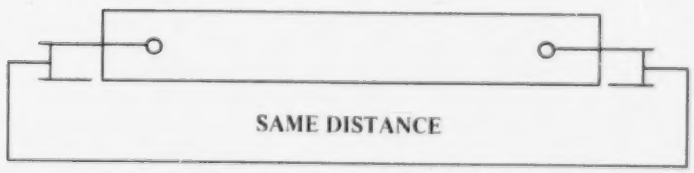
Method of constructing a plane table

1. Place one box on top of the other on their ends or sides depending upon your height.
2. Using the bolts, fasten both boxes together.



3. Fasten the paper to the end of the box, using the cellophane tape or masking tape.
4. Drive the brads or tacks into the ruler; both tacks must be equidistant from each edge.

12" RULER



These will be used as sighting guides during mapping.

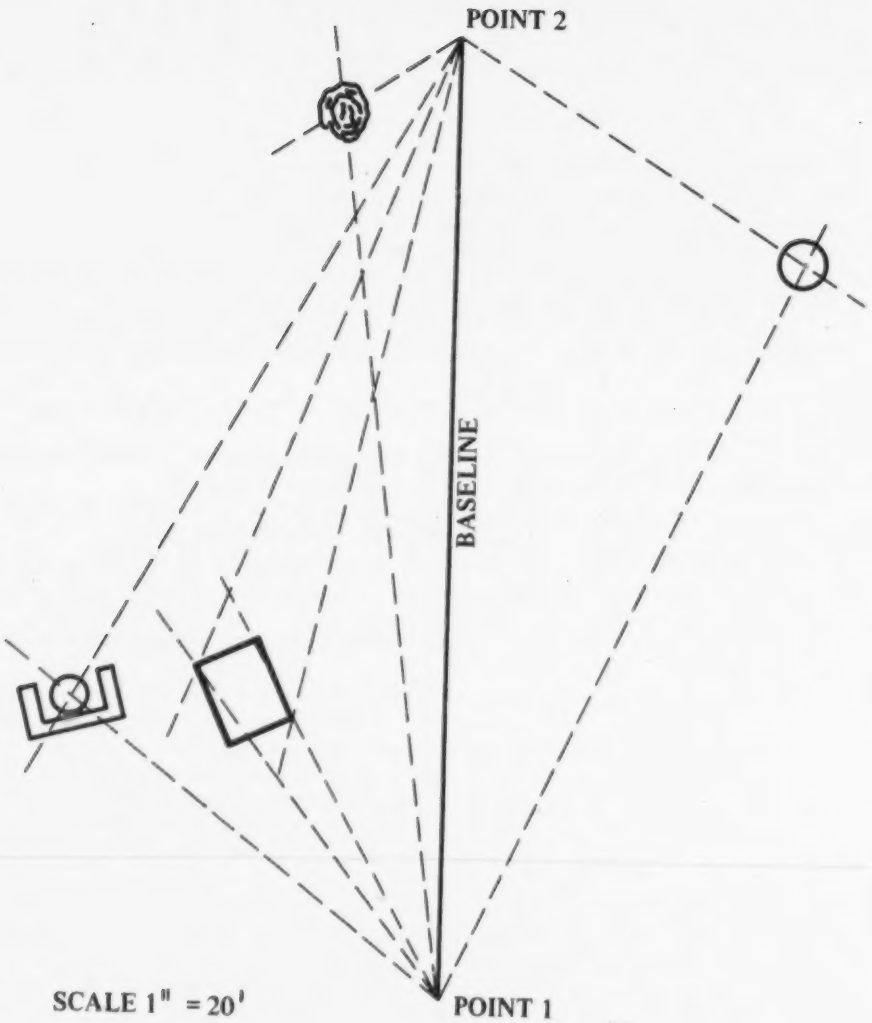
5. The table is now ready.

Mapping With The Plane Table

Two or more students should work together—some mapping and the others steadying the equipment.

Method of mapping

1. The size of the area to be mapped determines the scale of the map.
   Given an 8" wide paper, a scale 1"=100' will map a space 800' wide.
   Given an 8" wide paper, a scale 1"=40' will map a space 320' wide.
   Given an 8" wide paper, a scale 1"=20' will map a space 160' wide.
   (Since we are using standard rulers having inches and ¼ inches, the scale is best divisible by 4. Thus if 1"=40' then ¼"=10'. If 1"=20' then ¼"-5'. If 1"=80' then ¼"=20'.)
2. You must determine by observation and estimate, or by actually measuring the greatest distance between two objects to be included on the map. Your pace can be used to determine this distance.
3. Having decided upon a scale, now establish your baseline. Drive in the red-flagged stake at the base of the boxes.
4. Then pace across the longest distance that must be mapped and drive in another stake. The distance between these two stakes will be the only measurement needed.
5. Orient your map in the direction of this line. Draw this line on your map and place an X at each point. Label as Point 1 the location of your present point. Label the far one Point 2.
6. Lay the ruler so that one edge is along these points. Moving (turning) your box, line up the tacks or sight along the tacks from your present position to Point 2. This establishes your baseline on the map. The map must continue to be aligned with this baseline during all future mapping.
7. **The theory behind using the plane table is to locate points by intersecting lines. This is the next step you must take.**
8. Keeping the base (end) of your ruler on Point 1, rotate the far end until the two tacks line up pointing toward the point to be established, that is, the corner of a building, a tree, porch, telephone pole, etc. Continue this with all things which you wish included on your map. When you have completed this part, you will have a number of labeled lines radiating from Point 1.
9. Now move to Point 2. The map must remain in the same general position in relation to Points 1 and 2 as it did at Point 1, so re-orient the map. To do this, place the heel edge of the ruler along the baseline, stand so that Point 2 is closest to you on the paper, and sight back at Point 1 placing the boxes so that the tacks line up with the baseline.
10. When this is accomplished start again to take sights on the various objects, as you did at Point 1, with the exception that where your line from Point 2 crosses that from Point 1, you can now draw in the object with the knowledge that you have established its location.
11. This procedure may be carried on indefinitely by setting up a Point 3 beyond Point 2, etc. This could be a prolongation of the baseline 1-2 or it may be in another direction.
12. When you have finished your mapping, set up your scale, a legend, date the map, label the area, and have the crew members sign it.



CREW: MJ
DH
BT

DATE: JUNE 19, 1970
AREA: RANCH HOUSE LAWN

LEGEND

GATE

HOUSE

APPLE TREE

LIGHTPOLE

People in Your Town

How many people live in your town or city? _____

Do a lot of people come into your town during the day for business, shopping, work, etc.? If so, where do they come from?

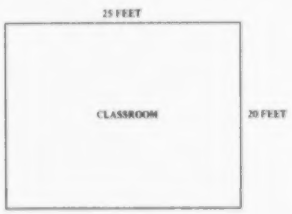
Is most of the population of your town located in the center or is it evenly spread out? _____ In order to find the answer to this have someone in your class contact your local tax assessor. When you receive your information, plot the population on a city map in your classroom.

Why do you think people live in cities?

Reasons why:

How large an area does your whole city occupy? _____ See if you can determine this by looking at a map.

How large an area does your classroom occupy? Using your pace, determine the length and width of your classroom. Multiply the length times the width. This gives the area of your classroom in square feet.



$$\frac{25}{\text{length}} \times \frac{20}{\text{width}} = \frac{500}{\text{square feet}}$$

Your Classroom:

$$\frac{\quad}{\text{length}} \times \frac{\quad}{\text{width}} = \frac{\quad}{\text{square feet}}$$

Next divide the number of people in your class by the number of square feet available. This equals the population density of your classroom, or the number of persons in a given area.

number of people	÷	number of square feet	=	population density per square foot

Knowing the number of people in your town and its approximate size, can you determine its population density? You can use square feet or square miles. Which is best?

What areas in your city or town are the most crowded? Locate these areas on the map of your city.

Areas:

If you have a chance, observe some of these most crowded areas. Are they similar in any way? _____ If so how?

Express how you feel about these areas using a sketch, a poem, a collage, etc.

Why do people live in crowded areas of their city?

Think about and look into the cost of living in crowded and uncrowded areas. Is there a difference? As a class you may want to complete the following chart:

	Crowded Area	Uncrowded Area
Average:		
rent		
food cost (per week per family of 4)		
utility cost (per month)		
electricity		
water		
phone		
transportation to work		

Does crowding in the city have anything to do with other problems such as poor schools, unemployment, or racial discrimination? How?

Do some experiments on crowding with your own class. For example, for one day try doing your regular class activities in half of the space you normally use.

It it pleasant to be in a crowd?_____, How do you get along with other students when you're crowded together like this?

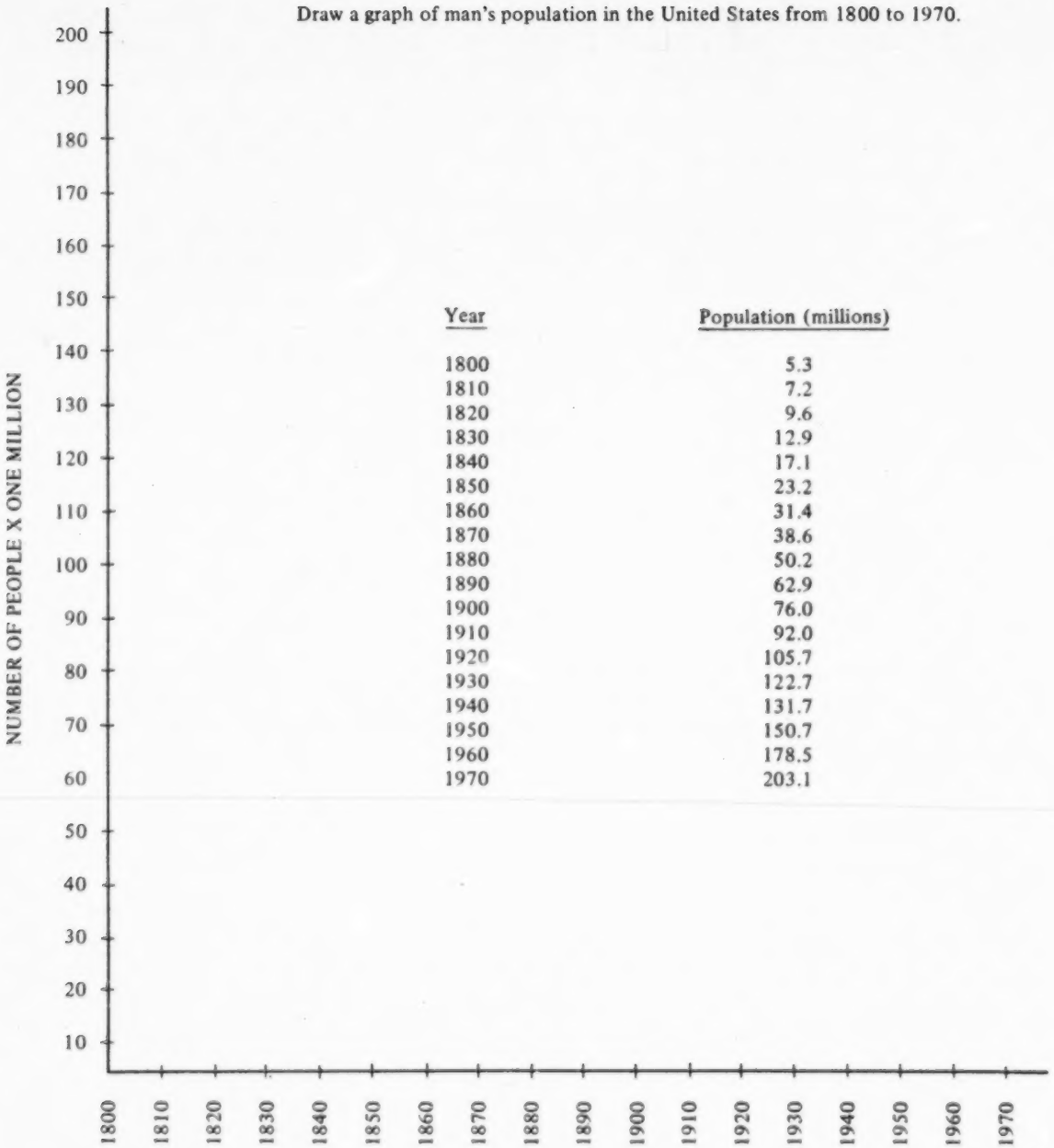
Using a short story, poem, or sketch describe how it feels to work in a crowded area.

In a park area or your city observe the activities of birds and animals such as sparrows and squirrels. Notice their behavior in relation to each other's area or territory. What do birds do when other birds approach an area where they are finding food?

What does man do when someone approaches his "territory"?

Thinking back on your study of population and the effects of crowding, how much space do you think an individual human needs to survive? Square feet _____ . Did other students in your class come up with the same figure?_____

Draw a graph of man's population in the United States from 1800 to 1970.



Year	Population (millions)
1800	5.3
1810	7.2
1820	9.6
1830	12.9
1840	17.1
1850	23.2
1860	31.4
1870	38.6
1880	50.2
1890	62.9
1900	76.0
1910	92.0
1920	105.7
1930	122.7
1940	131.7
1950	150.7
1960	178.5
1970	203.1

Think about the food you eat in one week. How much milk do you drink in one week? In 1970, the population of the United States was approximately 200 million. How much food would be consumed in a week if every person in the United States had the same amount as you? How much in a year?

_____	x 200,000,000 =	_____
Gallons You Drink in One Week		Gallons United States Could Drink in One Week
_____	x 52 =	_____
Gallons United States Could Drink in One Week		Gallons United States Could Drinking in One Year

Will people in the United States need more food 10 years from now? _____ Will they need more houses? _____ Why do you think so?

How many people are there in the whole world? _____ Listen and look for reports on population problems in other parts of the world. If you are interested, make a study of the population in some country of the world. What problems related to population is the country facing? For example, what do people there eat and how do they live?

Teacher's Page

Life styles and technologies have changed with lightning-quick speed during the 20th century. Our realization of this change is vivid if we think back to the homes we lived in just 20 years ago. For clothes and fabrics, synthetics and blends did not yet play a major role—and popular fashions changed a little less rapidly!

Today a greater variety of foods and brands is available. Frozen foods are used widely, and we have added "freeze-dried" to our vocabulary. Packaging plays a significant role in food marketing today. Trends in home building, both in materials used and in housing types, have changed in many parts of the country. In all these categories—clothing, food, shelter—think of the many changes you have seen for yourself.

Many kinds of recreation today require new equipment. Our home appliances are far more versatile and complex. We have much more choice when we select a personal vehicle. Phenomenal advances have been made in communications and transportation, including modern mass transit systems, high speed air travel, and space travel.

Most of us are surrounded today, at our desks and in our homes, by so many things that we don't have time to use them! We are confounded to realize how many resources are tied up in the material objects we seem to accumulate without even trying.

Some of our resources are renewable: trees grow back if a forest is carefully managed over many years; crops can be raised year after year only if the soil is not depleted.

Other resources are non-renewable: when minerals are extracted they can not be replaced except perhaps over geological ages of time; when open space land is converted to urbanized development, it is almost impossible to recreate the original open space and natural values.

Some resources are interchangeable, too. In constructing homes we can choose from a variety of materials; we don't have to use those which are scarce. The same is true in choosing materials and fabrics for our clothing; we can select clothing and other merchandise which are produced with the least environmental damage. No doubt you can think of many examples with respect to foods and product packaging.

There is another alternative: to consume less and do without some of the non-essentials. It's too bad to see our resources wasted when we all recognize that many resources could be put to good use in helping our children and other people around us to a better way of life. Today we are seeing more public concern and joint action to conserve our natural resources and use them wisely—and an even greater effort by everyone is needed.

YOUR TOWN: HOW IT WORKS AND SURVIVES

"Modern man seems to believe he can get everything he needs from the corner drug store. He doesn't understand that everything has a source in the land or sea, and that he must respect these sources."

–Thor Heyerdahl

Where does everything in your town come from? Certainly not from the corner drug store or the super market or the department store–where then? Your town is composed of much more than people, businesses, and houses. Your town functions as a complex net of interacting systems. These systems, when they function properly, keep you informed, housed, clothed, and well fed.

The systems of a city are something like the systems of your body. If your body is not properly cared for it will not function as it should. In this section we'll explore further the life support systems of a city and the people in it.

Essential Products

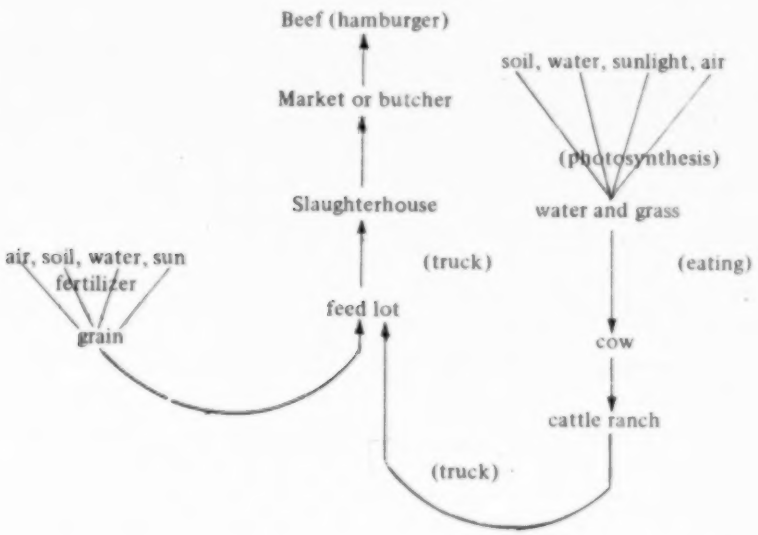
Using the chart, keep a week's record of all of the foods you eat. Compare your diet to that of the people in a country you previously studied. What are some of the reasons for the differences?

Types of Foods You Eat

	Meat and Fish	Dairy Products	Breads and Cereals	Fruits and Vegetables	Candy, Soft drinks, etc.
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					

Pick one of your favorite foods and trace back through all the steps it takes for that food product to get from the land to you. Find out exactly where the food product comes from. Does it come from far away? If so, how did it get to your town?

Sample of a food flow chart:



Your food flow chart:

How many steps has your food product gone through?

Do any of your foods actually originate from within the city? _____

_____

What land resources are necessary to provide the transportation for your food products? This gets fairly involved but it is interesting to discover how much you depend upon the earth.

Look around you in the classroom or in town. What non-living materials are present (such as wood, stone, plastic, etc.)? What are the sources of these materials? What basic ingredients go into the production of these sources?

Materials	Sources	Basic Ingredients
1. wood desk	trees	water, sun, air, soil
2. book		
3. sidewalk		
4.		
5.		
6.		
7.		
8.		

Pick an object which is made out of one of these non-living materials, such as a desk top or clothing, and trace all the steps it took to get the finished product to you from the original raw materials. Be sure to include the transportation and manufacturing steps that are involved.

Roughly speaking, how many people depend on the production and transportation of this product for their jobs and income? (A lot? a few?)

Water - Its supply and use

Water is a resource none of us can live without. Water has endless uses, and yet today we seem to be taking its availability for granted. As demands for water increase, we must utilize our water resources carefully since there is only so much available at any given time.

Where does your town get its water? Have someone from your class find out from your city government about how much water your town uses on an average day in the summer; in the winter.

Town's water source(s) _____
Average daily use (summer) _____
Average daily use (winter) _____

Is your town's water measured in any way? For example, is the amount you use measured with a meter? If so, how does this prevent water from being wasted?

Is your town's water treated in any way? _____

How is this done and what chemicals are used? Why?

What are the major uses of water in your town? Think not only about how families use the water but also about the industrial uses, etc.

Find out how much water your household uses in a day or month. You can figure out what the major uses of water are in your household by taking a few simple measurements. For example, a toilet uses about 7 gallons of water every time you flush it. Can you figure out how much water is used in:

1. the bath or shower _____

2. the clothes washer _____
3. watering the garden _____
4. personal consumption _____
   (drinking and cooking)

Does the water leave your household in the same condition as it came in? _____

How has it changed?

What happens to the waste water after it leaves your house?

Is there a sewage treatment plant in your town? If not, why not?

If the sewage is treated, what kind of treatment does it receive and where does it go after treatment? Locate this place on a map of your town.

The disposable environment?

A major problem today is the disposal of solid wastes. Not only do we have to worry about where to put our discarded cars and our aluminum, plastic, and glass containers; we must also concern ourselves with the depletion of the resources that go into making these products.

How and where does your town dispose of its garbage? Is this posing any problems for your town? What?

An interesting project is to figure out how much solid waste your household is producing per day. Using a bathroom scale, determine how many pounds of various types of solid wastes your household produces each day for a week.

Day	Cans and Metal (lbs.)	Paper (lbs.)	Plastic Products (lbs.)	Food Refuse (lbs.)	Glass (lbs.)
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					
	Total	Total	Total	Total	Total

Add the weekly totals of each type to discover the amount of waste your household produces in a week.

$$\frac{\text{amount per week}}{} \times 52 = \frac{\text{amount used per year}}{}$$

Think about the kinds of waste and why they come into your house in the first place. Could your household reduce the amount of waste it produces?

Kinds of waste	Ways you can reduce waste

Do you think any of these "waste" materials could be reused? If so, which ones?

Materials which can be reused:

Of the materials being thrown away, which ones originate from resources which can be restored by man? Refer back to the table you made of materials, sources, and basic ingredients on Page 44.

Resources which can be restored by man:

1.
2.
3.
4.
5.

How are these sources renewed? To find out, assign members of your class to contact the local agencies which deal with the land and its resources.

Of the materials being thrown away, which ones originate from resources which cannot be restored by man? Refer back to the table you made of materials, sources, and basic ingredients.

Resources which cannot be restored by man:

1.
2.
3.
4.
5.

As we slowly use up these resources which cannot be restored by man, what do you suppose is going to happen? Use a poem, a story, or a sketch to communicate what you think will happen.

Energy: critical needs or excessive wants?

In our "all electric world" we often take for granted the electricity we use for light, heat, and power. Most electrical power is generated by the combustion of stored fossil fuels, the controlled reaction of radioactive materials, and utilization of the potential energy present in falling water. Try to find out what effects the construction of new power facilities may have on your environment.

What is your town's source of electrical energy? _____
How is it produced?

How do you use electrical energy in your day-to-day life? For one day, keep track of the times you use electricity. Also list the purpose for which you used this electricity.

My daily use of electricity:

use	Purpose
example: 1. electrical can opener	1. open dog food can

How many of these uses could you do without and still lead a comfortable life?

There is currently a great concern in our country over power shortages. Can you think of any way to eliminate this shortage without producing more electricity and building more power dams; How?

How is your home heated?

What is the original source of this energy?

Industrial effects on your town

One of the main reasons for people moving to the cities in this century has been the location of jobs. People in the city depend upon their job for an income which will buy food produced in the rural area as well as other goods and services. Both good and bad effects result from an industry locating in a town. Jobs are created and income flows in the town, but negative effects can also occur.

What is the main industry (or industries) in your town?

About how many people in town depend on this industry for their living?

How might the climate affect the types of industries located in your town and their operations?

Think of the effects (both good and bad) that this industry has on:

land	animals	people
air	water	you
	the town	

Give some examples:

	Good	Bad
land		
air		
animals		
town		
people		
you		

Teacher's Page

Is pollution everywhere, or do people just make it sound that way? You can decide for yourself whether pollution is a problem in your community. Start sniffing, and listening, and looking carefully around you. Some of us have grown up with or become accustomed to objectionable odors, excessive noises, and offensive sights, but now these environmental conditions have become "pollution."

You can "feel" your environment, too. Do you notice the pavement under your feet? Can you feel the breeze? Do you prefer a city mall or a county park? We need to remember that man-made as well as natural environments can be pleasant.

When your senses tell you "pollution!", the time has come to track down the sources. The causes of pollution are usually complex. Factories, buildings, vehicles, sewage systems, power plants, resource extraction processes, towns themselves–all exist to produce the many things that people need and want. Generally speaking, there are several ways to reduce the pollution that results. Many conservation and other groups which offer solutions to our environmental problems have received nationwide publicity, so you can probably list many of their ideas, and your own as well.

Pollution occurs in agricultural and wilderness areas as well as towns. Some farm practices and development trends must be modified to protect these areas. Environmental changes in non-urban areas often occur more slowly, but over a period of time they reduce the amount and productivity of our Nation's lands and resources that are available to promote good health and enjoyment for everyone.

To recognize environmental pollution, it helps to understand ecology–the inter-relationships among living things and non-living things in the environment. Ecological relationships exist everywhere–deep in the city or out where the country is filled with plants and wildlife. Most of us need more knowledge about ecology. Such knowledge can help us determine standards for cleaner water and air, for rational land use, and for protection of all living things.

Institutions such as businesses and governments pollute, but we as individuals cause pollution, too. We should keep in mind that modern technology has brought man many benefits in terms of health, comfort, education, and communication. We do not want to throw these advantages away. But we should weigh carefully the pros and cons of complex inventions and development. We should evaluate our own demands and habits thoughtfully, and make personal choices which favor a healthier environment.

PROBLEMS IN YOUR TOWN: AIR, NOISE, WATER

Why problems occur

Pollution–Where does it come from and why does it occur? You can answer these questions for yourself by looking at the processes which various materials go through to become finished products. The production of goods and services for people usually has both good and bad effects. Bad effects occur in the form of pollution and good effects in the form of desirable products and employment. In an earlier part of this guide (Page 43), you traced the steps it takes for various materials to reach you as finished products. Now you can take a closer look at this process.

Think of a product that you use often. On the following pages, detail the steps it takes from: raw material → production → finished product → use → disposal. For each step decide what the good and bad effects are. Be sure to look at the processes involved in each step of production and also what happens to the product after it is used. This may take some research.

The product is _____

Raw Materials:

List:

What happens to the raw materials before they go through the production process?

good effects:

bad effects:

Steps in production:

List:

What effect does each of these steps have?

good effects:

bad effects:

Use of finished product:

What do you do with the product after you get it?

What effect do these uses have?

good effects:

bad effects:

Steps in disposing of waste from product or wornout products:

List:

What effects does disposing of this product or its wastes have?

good effects:

bad effects:

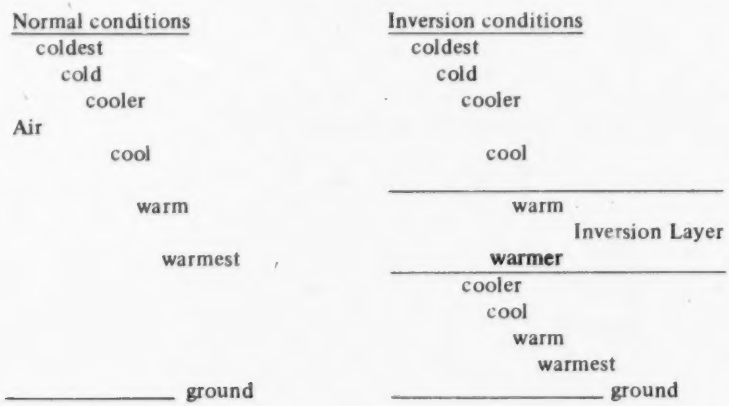
Air

Observe your city from a hill or tall building. What are the sources of the pollution you can see, hear, or smell?

Sources	Type of Pollution
example: incinerator – from burning waste materials	smoke in air

Locate and describe the source and type of pollution on a map of your city. Does this pollution occur near any residential areas? _____ If so, how might it affect the people who live there?

Notice the days when your city's air is dirtiest; find out what the weather pattern is on these days (high or low pressure, velocity, wind). Find out from the weather bureau in your area if inversion conditions ever exist. (Inversion conditions occur when a warm layer of air is trapped between two cooler layers of air.) This prevents the atmosphere from mixing, and air pollution could be more serious on days like this. See the diagram below.



From your exploration of the weather do you see any relation between days of bad air pollution and the weather patterns over your town? _____ If so, what is this relationship?

Do you think smoke can be emitted in large quantities on any day without causing an air pollution problem or should the daily weather patterns be considered before allowing smoke emissions? Why or why not?

A lot is said about how bad air pollution is and what a major problem it is, but have you figured out how it affects your life? Here are some questions and activities your class may want to try to help you learn more about the effects of air pollution.

At home or at school, designate as a dust indicator a table or similar surface. Leave it undisturbed for three days with a white handkerchief on it. After three days note the dust accumulation on the handkerchief and look at it under a hand lens or other magnifier. What does it look and feel like?

Do you have any idea where some of the particles came from?

Notice what accumulates on a clean car after it is left out overnight. Keeping this in mind, how do you think dirty air affects your life, or does it?

What would this air do to your clean clothes if they were hung outside to dry?

What might this air do to your lungs?

Now that you've thought about what dirty air does to man, what might this air do to affect other animals?

How do you think dirty air can affect plants?

How do you think air pollution is measured? You can learn about air pollution standards from an official of the local air pollution control office which monitors your town.

Use a poem, cinquain, sketch, story or anything else you wish to express how you feel about the air in your town.

If there is an air pollution problem in your town, set up a class project designed to help solve this problem. The use of games with students playing the role of various community groups is an exciting way to learn more about solving a community problem.

Here is an example of a simulation game which your class might want to try:

The Problem:

An industry in town is putting out great quantities of black smoke as a result of the burning of its waste products. The town is located in a valley which means the smoke is not blown away easily. A group in town has formed to stop pollution of the air. This group is complaining to the town council about the smoke problem.

The industry says it cannot afford to change its method of waste disposal. Other people in town oppose the control of the smoke because they feel it will discourage industry from moving to their town. They say this would prevent economic development.

The Players:

1. Town Council–This is the town's governing body which will decide whether the smoke pollution will be stopped. The purpose of the other groups is to persuade this council through their representative that their position is correct.
2. Industry Representatives–This group represents the industry which is causing the smoke pollution. They are naturally concerned with their interests and want to keep their profits at a maximum. However, they are interested in public opinion and may respond to public pressure. The group claims that their economic development will be harmed if strong controls on smoke emissions become law.
3. Citizens for Clean Air–This group is determined to solve the smoke pollution problem as soon as possible. Its members believe that a clean environment is more important than a profitable industry in town. The group also believes that the waste product being burned could be put to a valuable use. Most people in this group do not depend on the industry for their jobs.
4. Citizens for Economic Development–This group is composed of businessmen and also people who work for the industry causing the smoke pollution. They are siding with the industrial group since they are concerned with the town's economy. However, this group realizes that environmental quality is important and might seek a slow, gradual solution to the problem so that the industry is not hurt.

Procedure:

Divide the class into the various groups. Each group should meet and discuss what it wants the town council to do about the problem, and what the group thinks is needed to make this a better place to live. The ideas should be based upon some research into the problem, not just personal opinion. Elect a spokesman for each group to present its "case" to the town council when the class meets as a whole again.

The town council should elect one of its members to be in charge of the meeting. After listening to the representatives from the different organizations the town council should come up with a list of priorities—a list of what it is going to act upon first, second, etc. Your class may wish to invite a member of the real town council to meet with you and discuss your ideas.

Conclusions:

What solutions to the smoke pollution problem did the members of your class think were the best?

What is your own opinion about the smoke pollution problem above?

If your class found the smoke pollution problem interesting, you may want to find out if there are groups in your town discussing or working together on a major problem concerning land use, air pollution, noise pollution or water pollution. Perhaps someone in your family is interested in pollution problems. Also, your local newspaper probably has articles on major problems in your town.

List your town's major problems:

Which of these problems is the most serious right now?

What persons or groups are involved in this serious problem?

The class may wish to invite someone to discuss this problem. Think about the ways members of your class might help solve this problem and discuss your ideas with your guest.

List several ways you can help solve this problem:

Noise

Recall what sounds were heard in the first part of the guide, Page 17. When and where were the sounds the loudest and the most common?

Look again at the map your class made on population density (Page 35). How does the location of loud sounds compare to the parts of your town which are most crowded?

How do these locations compare with those from which the air and water pollution in your community are coming?

Is there any relationship between water and air pollution and noise pollution?

If you think so, what is the relationship?

Could noise pollution have a bad effect on people? How?

Have you ever heard a noise so loud you couldn't stand it? What caused the noise, and what did you do?

What are the regulations controlling noise in your town?

Do you know how noise is measured? Can someone in your town help you learn about this? Record what you find out:

List some animals, birds and fish you know about. How much noise can they tolerate? Is it more or less than man can tolerate? What activities of these animals do loud noises disturb?

As a class choose one object with an annoying noise and try to quiet it.

Object:

Method used to quiet noise:

Was it successful? Why or why not?

What object would you like to quiet the most now?

How would you go about doing this?

Describe by either a sketch or a poem why you find this noise annoying.

What river or creek runs through or near your town? _____

Where does it start? If you do not know, look at a state map or a map of the United States.

What happens to this river or creek as it flows to join a larger body of water or the sea?

Where are most of the towns located on the river or creek: near the beginning or where it joins a larger body of water?

What do you think will happen to this river or creek as it runs through the town? What materials will probably be added to it?

What materials will probably be taken away?

With your class, travel to a place along the river or creek upstream from your town.

With one word describe how the river smells. _____
With two words describe how it looks. _____
With three words describe how it feels. _____
With two words describe how it tastes (if safe). _____
With one word describe how it sounds. _____

What materials do you see in and along the water which don't really belong there? For example, are there any old tires or tin cans? What else?

List of materials found:

What can you do to help correct this problem?

What plants and animals do you find living in the water?

Plants: name, describe, or sketch	Location (edge, middle, etc.)

Animals: name, describe or sketch	Location (edge, middle, etc.)

Animals that live in the water cannot stand too much acid or alkali in the water. Using a pH kit, test the water to determine how acidic or alkaline it is. Follow the directions found in the kit.

What is the pH of the water tested? _____

Looking at the chart below, what animals would most likely be found here?

What plants would be found here?

pH Ranges that support aquatic animal and plant life

Most acidic	Neutral	Most alkaline
1	7	14

6.5-7.5
largest variety
of animals, trout,
mayfly, stonefly,
caddis fly

7.0- - - -9.0
snails, clams

6.5- - - - -8.5
bass, crappie

6.0- - - - - - -9.0
carp, suckers, catfish,
some insects

6.5- - - - - - - - - - - - -12.0
plants (algae, rooted, etc.)

1.0- - - - - - - - - - - - - - - - - - - -bacteria- - - - - - - - - - - - - - - - - - - -13.0

All life needs oxygen in order to live. Pollution reduces the amount of oxygen in the water. So do water plants. Using the pH kit, test for the amount of usable oxygen present in the water. Follow the directions given in the kit.

What is the water's oxygen content?_____

Looking at the chart below, how much life can this amount of oxygen support? _____

Useable oxygen in ppm reading	Variety of life
below 5	very little life can survive
above 5	large variety of life

Now travel to a place on the river just below the town and examine the water. Using all your senses describe the water in the same manner as you did upstream.

_____

_____ _____

_____ _____ _____

_____ _____

_____

Do you find the same type of materials, such as cans and paper, in and along the river as you found upstream?

List the materials you find here:

What plants and animals do you find living in this part of the river?

Plants: name or describe	Location (edge, middle, etc.)

Animals: name or describe	Location (edge, middle, etc.)

What is the pH of the water here? _____

Looking at the previous chart, what animals would most likely be found here?

What plants would be found here? _____

What is the oxygen content of the water here? _____

Looking at the previous page, how much life can this amount of oxygen support? _____

Is there any difference between the water above and below your town? _____ , If so, what and why?

Where did you like the river the best? _____ Why?

Make a drawing of what the river would look like if it ran through a hundred towns just like yours. Would you like to live in a town along this river?

After finding out about your town, its life support systems, and its problems, describe how you would most like your town to change and why. Use a sketch, a poem, a story, or anything else you wish.

SECTION III

Nature's Ecosystem

Teacher's Page

Even before we step outdoors, there is much to be learned about ecological inter-relationships. Start with the principle that every living organism is related to the organisms (plants and animals) and the basic substances (sunlight, air, water, and soil) in its environment.

We all know more than we think we do about living organisms, so we can recognize their role in ecology by asking some questions about inter-relationships. To understand more, use the beaver as an example.

What are the beaver's roles in Nature?
Where is the beaver's home?
What organisms and substances in its environment does the beaver depend upon for survival? How does it use these organisms and substances?
What effects does the beaver have on other organisms and substances?
What organisms and substances in this environment depend upon the beaver? How do these organisms and substances use it?
What effects do other organisms and substances have on the beaver?
Where does the beaver fit into the food cycle in its environment?
How does the beaver reproduce?
How is the beaver affected by climatic conditions?
What adaptations has the beaver developed to suit itself to this environment?

Even though it will take some time, you can begin to see the variety of inter-relationships which occur in Nature if you will select one or more plants or animals you are familiar with and utilize these general questions again. Don't forget that one "organism" found in many environments is Man!

In studying the ecological role of several organisms, you will probably begin to notice that, while different organisms are the components of ecosystems in different parts of the world, certain types of inter-relationships appear in all or most of them. Also, some ecosystems enjoy a much greater abundance of organisms that others, and you can try to identify factors in each ecosystem which influence the number and variety of organisms. You can also try to draw some conclusions about the stability or fragility of ecosystems with certain environmental conditions and a greater or smaller variety of organisms. "Fundamentals of Ecology," by Eugene P. Odum, is an excellent book for learning about basic ecology. These ecological principles are applicable to all the natural resources issues and decisions we face today.

Did you notice that "ecology" questions didn't ask about "good effects" or "bad effects"? That is because the ecological inter-relationships in a natural ecosystem generally create a natural balance. Certain climatic and geological conditions and certain organisms may have adverse effects on the dominant components of an ecosystem on a short-term basis, but over the long run, it appears that systems of ecological relationships regulate themselves. That is one reason we must assure that man's actions harmonize as much as possible with the ecological inter-relationships in his environment, so that he will not upset this natural balance.

INTER-RELATIONSHIPS IN NATURE

Before you go outdoors, investigate some basic ideas about the natural environment.

BASIC NEEDS

Every day we work, we play, we eat, and we rest. To do these activities, we must use resources that come from our environment. Think about the things you use every day.

To live, I need:

1) 6)
2) 7)
3) 8)
4) 9)
5) 10)

It would be interesting to compare your list with lists from other members of your class. Discuss why you need the things on your list. Could you live without some of these things? Try to separate the needs that are really essential from the things that are just nice to have.

To live, I need these essential things:

Choose one of these essential things to think more about. Where did it come from? What are its basic ingredients?

Choose an animal you are interested in. It may be a pet, an animal you saw in the zoo, or one you have studied._____This animal has basic needs, too. List the essential things it needs to live:

Which essential things from your two lists are found in Nature?

Which are Man-made?

Found in Nature	Man-made

Picture yourself or a favorite animal surrounded by the essential things in his environment. Use a poem, a sketch, a story, or anything you wish to show this.

THE WEB OF LIFE

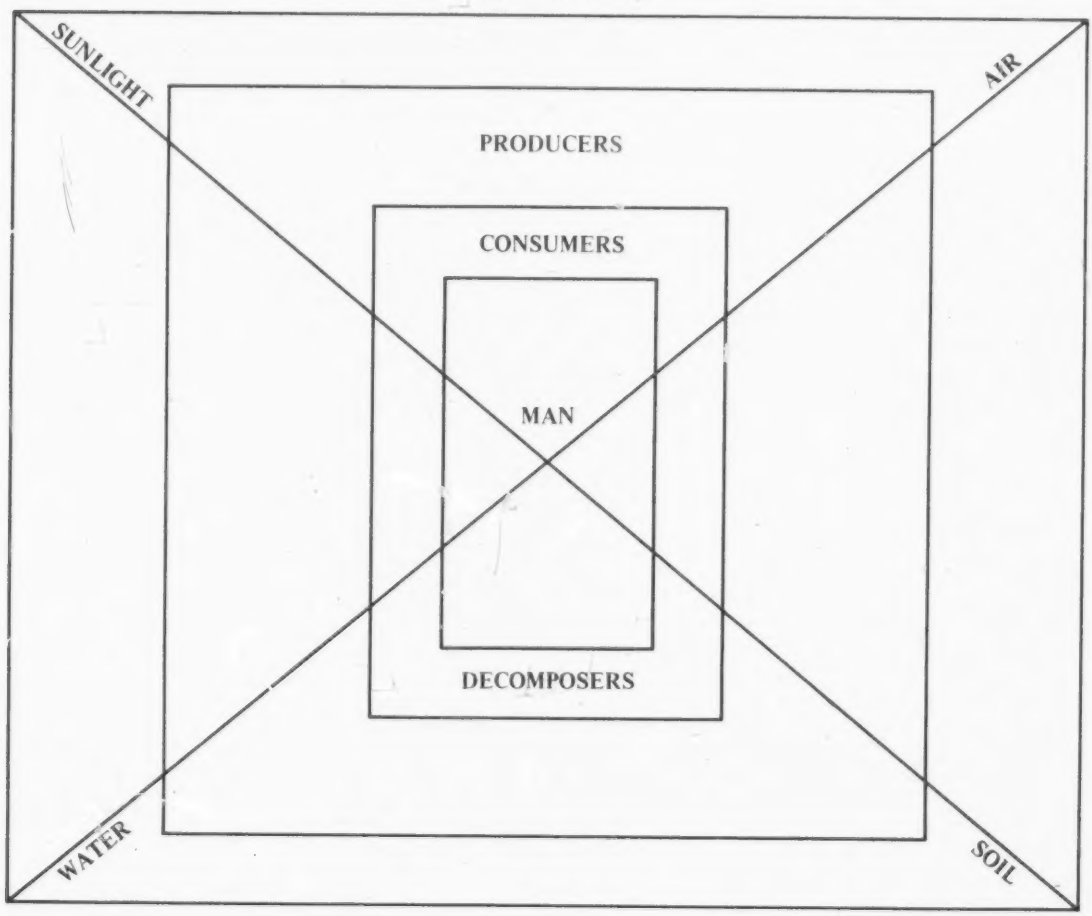
Every living thing depends upon its environment for survival. Man, animals, plants, sunlight, water, air, and soil all exist in the world. But you really can't study each one separately, because they are all related to each other.

For example, water helps Man in many ways. But it can also harm him. List some of the ways water can affect Man's life.

Helpful effects	Harmful effects

The inter-relatedness of all living things in the environment is called the Web of Life.

THE WEB OF LIFE



The Web of Life describes everything that exists in Nature. When you think of Nature, do you include Man?_____ In the diagram Man is shown in the center of the Web of Life. Must he always be in the center? Choose something in Nature and think of ways in which Man can affect it.

Object in Nature: _____

The possible effects of Man on this object are:

Most producers of raw materials are green plants and trees. They use sunlight, air, water, and soil to produce food for animals. List some producers. Which ones are usually found in your town? Which ones are usually found in the country and in the woods?

Producers (name or sketch)	Place usually found

Most consumers are animals, large or small. Some consumers depend for food mainly upon plants. These consumers are called by the special name herbivores. List some herbivores. If you can, name the plants they depend on for food. Do some herbivores depend on more than one plant?

Consumers-Herbivores (name or sketch)	Plants consumed for food

Some consumers depend for food mainly upon other animals. These consumers are called carnivores. List some carnivores. If you can, name one or more animals they depend upon for food.

Consumers-Carnivores (name or sketch)	Other animals consumed

Did you discover that some consumers eat both plants and animals? _____ These consumers are called omnivores. List some omnivores. If you can, name the plants and animals they depend upon for food.

Consumers-Omnivores (name or sketch)	Plants and animals consumed

Do you think Man is a consumer? _____ If so, is Man an herbivore, carnivore, or omnivore? _____ Do all the people you know or have read about eat the same kinds of food? Describe the foods your family eats and the reasons for eating them.

Most decomposers are bacteria and fungi. Bacteria are microscopic animals, and fungi are plants. Decomposers break down the decaying parts of plants and animals and return them to the soil where they can contribute to new growth. Try to explain why you think decomposers are important in the Web of Life.

Think about sunlight, air, water, and soil. They are basic ingredients in the Web of Life. Are they living things? _____ Why, or why not?

Choose a favorite plant. _____ Why does it need sunlight, air, water, and soil?

Choose a favorite animal, large or small. _____ Why does it need sunlight, air, water, and soil?

Now think about yourself. Does Man need sunlight, air, water, and soil? _____ Why, or why not?

Earlier (Page 72) you tried to name things in your environment which are essential to your life. If you would like to add or subtract from the list you made, try again to list your basic needs.

To live, I need these essential things:

What would happen if one of these essential things was removed from your environment? Use a poem, sketch, story, or anything you wish to show how the parts of the Web of Life are important to you.

When you go into the outdoors, try to remember the Web of Life and its inter-relationships, and see what examples of these inter-relationships you can observe in Nature.

Teacher's Page

Whenever you go into a natural environment, try and arrange for a little time to spend by yourself in a place you especially enjoy. You can learn a lot about the outdoors from the knowledge and enthusiasm of other people, but there is a particular pleasure in exploring and discovering some of Nature's secrets and surprises for yourself.

Sunlight adds a large measure of beauty to the outdoors. Watch the long shapes which sunlight creates in the trees or the fields. See it glisten through the leaves with a luminous sheen, with a color all its own. Notice the glowing life it brings to the green and gold, to all of Nature's colors. Notice, too, Nature's patterns and textures in leaves and petals, branches and waving grasses.

What can you feel here? The breeze, for one thing. But can you hear it, too? There are many effects in Nature that seem, somehow, to play on all our sensations, of touch, of hearing, of taste, in a subtle way which may bring peace and calm to our whole being. The crispness of winter's frosty air, the crackle of brittle autumn leaves under foot, the earthy springtime odor awakening in a dark, furrowed tree trunk, the moist, spongy carpet of the earth itself, teeming with newborn life—all the elements of Nature may appeal to our senses. Nothing can soothe us more than the gentle splash and gurgle of a clear stream, slowly making its way among the smooth stones. And when we hear the birds, answering one another from tree tops near and far, we feel as though it has been this way every spring morning for a million years.

Maybe you can put your knowledge of rhyme and meter to work and communicate your own enjoyment of a particular place to a special friend through poetry. Somehow, Nature, at any time of year, brings to us a calmer perspective and a sense of renewal.

IN THE NATURAL ENVIRONMENT

Using your senses

Look all around you.
Listen to the sounds—the quiet.
Touch the earth—the trees.
Sniff—there are lots of things to smell.
What do you see? What do you hear? What do you smell?
Write a cinquain about being here:

_____

_____ _____

_____ _____ _____

_____ _____ _____ _____

_____

Use a sketch or picture to show what you like best about this place. Some aspects of Nature (sound, odor) cannot be sketched. If you cannot sketch it, decide what type of communication you could use to share with others how you feel about this place.

On the following charts, list natural and Man-made things you see, hear, and smell.

Things I see: (name or sketch)

Natural	Man-made

Things I hear: (name or sketch)

Natural	Man-made

Things I smell: (name or sketch)

Natural	Man-made

Try to imagine how this place looked 100, 1,000, and 10,000 years ago. What things do you suppose were different? Make some sketches showing how you think this place looked in the past.

Do you think Nature or Man has caused the most changes over these years? List some changes you think have occurred or are occurring now.

Changes caused by Nature	Changes caused by Man

How do you think this place will look 100, 1,000 and 10,000 years from now? Make some sketches showing how you think this place will look in the future.

Who owns this land?

How is this land being used?

How do you think this land will be used in the future?

Who will decide how it will be used?

My favorite thing here is _____
Because

The things I like least about the place is _____
Because

2

Pretend this land is yours; you can change the things you don't like, and leave the things you like the way they are. How will you decide?

How would you like to see this land used? Use a sketch, a poem, a short story, or anything else you wish.

Teacher's Page

Soil is a basic and vital substance composed of tiny rock particles, air, water, and decaying organic material. Soil builds up very slowly over the centuries. Living organisms depend on it for nutrients, minerals, moisture, and physical support.

You have probably noticed that soils differ in depth, color, and texture from one place to another. In some soils clay predominates; in others, sand or silt. Geological conditions, topographic features, climate, water sources, and the composition of the plant and animal community all affect the condition and composition of the soil. Soil problems differ from place to place, too.

Soil is a valuable resource we cannot afford to lose, yet every year millions of tons are lost to rivers and streams as sediment. In mountainous areas, the soil is subject to serious landslides and spring flooding because of excessive rainfall or the melting of snow. The soil needs a stable ground cover, a good variety of roots and vegetation to hold it. Once erosion begins, whether Man-made or natural, it is difficult to re-establish vegetation. The soil becomes thinner as subsequent erosion takes its toll and may become unfit for plants and animal life. In some places, urban development has taken place on delicately-balanced slopes, and dangerous landslides have followed. In other places development has taken rich cropland soils out of production.

In grass and pasturelands soil may wash away, too. The roots of many grasses grow 2 feet deep or more, but overgrazing can denude the lands just the same. In the American Southwest, where many chaparral or desert-like regions are grazed, soils are characterized by very high sand content and little moisture. Vegetation is sparse and spreads itself at intervals to make maximum use of the available moisture. As a result, a minimum of plant and animal life is returned to the soil as organic matter. Rains seldom come. When they do, a flash-flood may occur if the sandy soil cannot hold the moisture. Some desert areas may be swept bare of soil by wind erosion, too.

In areas of fertile cropland, soil nutrients can be depleted if rotation of crops is not practiced. A thick, fertile soil cannot afford to lose its valuable store of minerals, nutrients, and moisture to the same plants year after year. A variety of plants will take different amounts and kinds of these elements from the soil. As these plants and the variety of animal life associated with them die and decay, they will return rich organic matter to the soil so that nutrients and minerlas can be recycled.

The soil in river and ocean beds is important, too. Many aquatic animals have suckers, tubes, and other appendages which permit them to cling to the waterbed or burrow into the soil. If a layer of sludge or sediment is deposited over their habitat, these animals will probably float at the mercy of the currents, unable to adapt rapidly to an altered environment.

Soil

Wherever you're standing, look down around your feet.
What's there?
Is anything growing there?
Move to to a place where you can pick up a handful of soil without harming any living thing.
Look closely. What is the soil made of?

Feel it. How does it feel? Is it gritty, smooth, or sticky?
Smell it. How does it smell?

Take a short walk, do these same things on another spot, and ask yourself the above questions again.

How are the soils in the two places different? How are they alike?

Differences	Similarities

Why do you think soil is important in Nature?

THE EFFECTS OF CLIMATE ON SOIL

When you looked at the soil, did you see any pieces of rock? Over a period of time rocks are broken down by weather to form new soils. Think about the climate or weather in your area:

1. What variations of temperature do you have during the year?
2. Is there a lot of rain? Is there a lot of snow?
3. Does the rain come evenly throughout the year, or does the area receive heavy rains and occasional floods?
4. Are there strong winds?
5. How does weather affect the speed with which rocks break down in your area?
6. How does weather affect the types of plants and animals that can live in your area?

ORGANIC MATTER

When plants and animals die and decay, they contribute organic matter to form new soil. The waste materials from living plants and animals also become organic matter for the soil.

Choose a plant big enough for you to inspect it closely. What will it contribute to the organic matter?

Plant (name or sketch)	Contribution

Choose any animal you have seen or suspect to live in this area. How will it contribute to the organic matter?

Animal (name or sketch)	Contribution

What about Man? What contribution do you and your activities make to the organic matter?

Man	Contribution

TOPOGRAPHY

Topography is the slope of the land; it may be steep and rugged, gentle and rolling, or any combination. Lakes, rivers, and mountains are included in the topography of an area.

How does the topography here influence water runoff and erosion?

How do runoff and erosion affect the soil?

Look for an example of water runoff or erosion. Use a sketch, cinquain, poem, or anything you wish to show the way topography can affect runoff or erosion.

How does the topography affect the types of plant and animal life than can survive here? How does this affect the soil?

SAMPLING

Perhaps you've wondered what lives in this area beside the plants and animals that you can see. Many smaller organisms, including lichens, fungi, and bacteria, are members of the living soil community.

To discover how all of the living organisms fit within the Web of Life is the job of the ecologist. He studies all living members of a particular area in detail. He tries to understand how they are inter-related and dependent upon each other.

Since the ecologist cannot look in detail at all of the large area, he studies small units of land within the area. This is called sampling. From the information he collects, he can make estimates of what is living in the entire area and what inter-relationships are occurring.

When you do a sample, try, like the ecologist, to understand how the living organisms you see are inter-related.

Equipment Needed:
- hand lens
- hand spade
- plastic containers with lid for collecting study specimens
- box lid or sheets of paper for inspection of soil organisms.

For your sample, mark off a 12" square section with sticks or rocks. Carefully inspect all you see on the surface of the plot and record what you find on the following chart.

SURFACE FINDINGS

Animal (name or sketch)	Number

Plant (name or sketch)	Number

Examine the plot to a depth of 2" or 3" by digging up individual clumps of soil. Gently shake the soil from the plant roots into a box lid or on a piece of paper. Record the life you find in each upturned piece of sod. After your investigation, be sure to replace the sod clumps in their original places.

SUBSURFACE FINDINGS

Animal (name or sketch)	Number

Plant (name or sketch)	Number

Decomposers break down the organic matter in the soil. Can you see the work of decomposers in your soil samples? Describe what you see.

How do you think decomposition of organic matter affects the soil?

How do you think the decaying of plant roots affects the soil?

How do you think the soil is affected by the burrowing of earthworms and other animals?

How is the soil beneficial to the plants and animals living here?

How is the soil beneficial to you?

Use a poem, a cinquain, a sketch, or a story to describe all the life you imagine is going on in the soil.

Teacher's Page

Man needs water for life, and so does every living thing. It is interesting to think how many functions water has, and how water's functions in the natural environment compare with those in a Man-made environment.

For both plants and animals, water is the essential medium in which basic life processes–reproduction, respiration, food manufacture and digestion, growth, and excretion–take place. This is true for man as well; in fact, the major portion of the human body is water.

Many organisms use water for transport. In both marine and freshwater environments, currents carry plants and animals hundreds of miles. Rivers transport seeds, and provide a highway for fish and a place for some fish to spawn. In Man's society, people, travel, and freight are hauled down the river and across the oceans.

Water is also a cooling agent. Temperatures in water change much more slowly than on land. Water provides favorable temperatures for the reproduction and growth of many species. It also cools and lends moisture to the air, thus protecting plants and animals in the terrestrial environment from intolerable levels of heat and aridity. Man feels the cooling effects of water, too. In many parts of the world, human settlements are located near water to take advantage of this. In modern industry, water is used as a coolant in many manufacturing processes. Water which is discharged back into rivers or oceans at a higher temperature may have adverse effects on organisms accustomed to cooler waters; thus, thermal pollution may result. Nowadays, water is an important part of the air conditioning that is used so much in our cities.

Water also provides protection for many living organisms. For many plants and animals in Nature, the water is their home. Water prevents excessive heat, air, and sometimes foreign matter from reaching them. Its fluid character and depth permit some aquatic animals to hide from or escape their would-be captors. It can also protect a natural area from wildfire. Water helps protect Man and his home from fire, too. It can also serve as a shock absorber to soften our landing if we fall, to cushion mechanical processes, and to reduce the effects of some geological disturbances.

Water functions in many other ways in both the natural and the Man-made world. Man uses enormous quantities of water in many ways, every day. What other roles does water play in our lives?

Water

How would you define water?

How does it look?
How does it sound?
How does it feel?
How does it smell?
How does it taste?
Use a poem, a cinquain, a sketch, or a story to describe how you feel about the water in this place.

What kinds of plants and animals live in this water? Using your hands, a dip net, and a hand lens, investigate in and around the water. Remember to put back where you found it anything you study.

On the following page, list the water life you find.

FINDINGS

Animal (name or sketch)	Number

Plants (name or sketch)	Number

Miscellaneous findings	Number

THE WATER HABITAT

Think about the kinds of animals you have observed. What part of the water and its surroundings does each animal choose for its habitat, or home? Select several different kinds of animals. Describe their habitats and try to explain why each animal lives where it does.

Animal (name or sketch)	Habitat	Explanation for habitat

Do you think there are other kinds of animals in and near the water that you cannot see easily? Where are their habitats? Why do you think they live where they do?

Look again at the plants you have observed. Do you find different kinds of plants in different areas of the water? Describe some of the differences you see and try to explain them.

Do some of the plants and animals here depend on each other? In what ways? Describe several examples of interdependence you see, and try to explain hem.

How do you think the animals here affect the water?

Do plants affect the water, too? In what ways?

Look carefully around the edge of this body of water. Is the water level high or low? _____ How can you tell?

Low water can have important effects on the lives of plants and animals. Try to think of several examples.

Name or sketch	Effects of low water

High water can have very important effects on plants and animals, too. What do you think they are?

THE HYDROLOGIC CYCLE

The water supply here comes from the hydrologic cycle. This cycle is a never-ending process. Water is carried from the ocean through the atmosphere. It comes to the land, then to the rivers, and then back to the ocean.

The massing of air over the ocean collects water or moisture through evaporation. As these clouds move over the land, they rise higher. There they are cooled, and moisture is returned to the land in the form of dew, rain, hail, sleet, and snow. Rivers then carry the water back to the ocean where the cycle starts again.

Make a drawing that will help you understand the hydrologic cycle.

Do you think the hydrologic cycle is important to Man? Why or why not?

Make a rough map of the body of water here. Can you see any tributaries (springs, rivers, and streams pouring water into this body) which should be added to the map? You may want to include the human settlements and Man-made facilities around this water which affect it. If you would like, show some of the fish, plants, and anything else about the water that interests you.

Using your map, try to explain something about the hydrologic cycle. What stages of the cycle can be demonstrated in this place?

MAN'S USE OF WATER:

How is Man using this place? Think of as many ways as you can.

Do you think Man's activities affect the water here? How?

How does your visit affect the water and the plant and animal life here?

What do you think the best use would be for this place? If you wish, describe more than one use.

Would any changes be necessary to make the best possible use of this place.? What would you have to do to make these changes?

Do you think this water is pure enough to produce fish safe for eating?

Is it pure enough for you to swim here?

Is it pure enough for you to drink?

With jars or bottles, you can take back water samples for testing. Can you think of someone in your school or community who can test them?

If the water samples can be tested, make a record of the results.

If it is possible, arrange for your class to visit the water filtration plant and sewage plant for your community.

Teacher's Page

Plants play a unique role in the environment because they synthesize the energy upon which the other organisms rely. These organisms include not only Man and other animals, but the decomposers (bacteria and fungi) as well.

A quick review of the photosynthetic process by which plants manufacture food may be helpful. In photosynthesis, plants combine water from the soil, carbon dioxide from the air, and radiant energy from the sun to produce a food sugar substance. This process requires the presence of chlorophyll. The food substance takes the form of seeds, nuts, and fruits, which are important food sources for animals. Oxygen and excess heat are also given off during this process.

At each subsequent level in the food chain, a consumer or decomposer obtains energy in the form of minerals, nutrients, and water from the food it consumes. But since some of this energy is released through respiration and excess heat, some energy is lost to the atmosphere (from which it came) at each level. Since some energy is lost at every stage, the earth must produce a greater mass weight of plants than is necessary to support the energy needs of consumers and decomposers in the food chain. Scientists are using several methods to determine the amount of energy produced by certain plants. They know that cropland can be more productive if it is used for several crops on a year-round basis without permanently depleting the nutrients, minerals, and water from the soil. In natural settings, a variety of plants is usually better than just a few species. A variety of plants can combine the sun's energy with carbon dioxide and available moisture at different seasons of the year to produce more total energy.

Plants

Look at the plants all around you. How many kinds of plants would you guess there are here?

What colors are the different plants that you see? Which do you like best? Why?

The colors I see are:

The colors I like best are:

Because:

Sniff some of the plants. Try to find some that smell differently and describe their odors.

Plant (name or sketch)	Description of odor

How do the different plants feel to your touch? Find some that have leaves, petals, fruits, or stems that are unusual to touch. Describe how they feel.

Plant (name or sketch)	How it feels to touch

What kinds of plants do you find here? List them and tell why you think they are important or useful.

Plant	Importance or use

Think about the most important plants in this place. Did Man plant them, or were they introduced to this place naturally? If they were introduced naturally, how do you think they got here in the first place?

Most plants reproduce from seeds. Look closely at several plants. Where is the seed in each plant found? What is Nature's way of planting the seed?

Plant (name or sketch)	Location of seed	How seed is planted

Plants have many different kinds of roots. Examine several roots, sharing them with the class so that you do not pull up too many and disturb the environment unnecessarily. How do roots help each plant to live and grow? Are all roots the same in size and appearance? If not, how are they different?

How do the changing seasons affect the plants living in this area?

In winter?

In spring?

In summer?

In fall?

How has Nature affected the life and growth of the plants in this place? Animals, different kinds of weather, and different water conditions have possible effects. How has Man affected the plants living here? Man may use them for food, for manufactured products, and for enjoyment. List specific examples for natural and human influences on plants.

Natural influences	Influences of Man

In the previous chart, look again at the effects of Nature and Man on plants.

Which effects do you think are beneficial or good effects? Why?

Which effects do you think are harmful? Why?

How are the plants here related to each other? Are some plants dependent upon others? You may have to look very closely. You may also have to use your imagination. List several ways plants can be important to each other.

How are the plants important to the animals living here? Look closely so you will notice small animals, too. Try to identify several sets of inter-relationships between plants and animals.

Plant	Animal	How plant is important to this animal

Are the plants here important to you? If they are, see how many reasons you can list:

Are the plants in this place like the plants in your yard at home? Are they like the plants in your schoolyard? Discuss how they are alike, and how they are different.

Choose a plant you like and try writing a cinquain to describe it.

Teacher's Page

Think of the many different kinds of environments in which plants and animals are found. There must be some factors which limit where each of these organisms can live. Some possible limiting factors are temperature, light conditions, water conditions, content of atmospheric gases, availability of nutrients and minerals, soil conditions, fire conditions, and currents and pressures. For any specific organism, certain limiting factors are more critical than others. Also, changes in limiting factors may or may not be critical, depending on whether a terrestrial, marine, or freshwater environment is involved.

Every species has its own minimum requirements. The availability of water, nutrients, temperature, and other limiting factors helps determine where each species will be found. At the same time, each species has tolerance levels for other factors and will be found only where these levels are not exceeded. Some plants and animals, of course, have a wider range of tolerance; they may be found over a broader geographical area and may also be more resistant to environmental changes. In addition, many species are found under a variety of environmental conditions because these species have been able to adapt or adjust their tolerance levels.

If you are trying to identify the factors which limit a particular species, it may be easiest at the margin or edge of its geographical range. Then, if environmental conditions change–for example, an extremely cold winter, a very dry season, an increase in water salinity–you can study directly the effects of these factors upon the organism and determine whether the factors are limiting. On the other hand, the health or behavior of an organism can serve as an ecological indicator that an environmental change is taking place. Thus, if mortality increases markedly in an estuarine population, you are prompted to investigate whether the salinity, the chemical content, the temperature, the oxygen supply, or the turbidity of the water is changing.

Some organisms require different environmental conditions during different phases of their life cycle. For example, the eggs or larvae of animal species may be far more sensitive to changes than the adult organisms are. Seeds may germinate and sprout only when certain soil and moisture conditions prevail. The limiting factors which cause a marked increase or decrease in the number or condition of a species may sometimes be difficult to identify unless all stages of an organism's life cycle are considered.

There are several different terms applied to the place in which a species is found. An organism's habitat is the broader geographic area where environmental conditions the species can tolerate are found. But an individual organism or a family group usually restricts its activity to a definite area, its "home range." If it actively defends a specific area against invaders, especially during periods of nesting or raising its young, this area is its "territory."

An organism is also placed according to its niche. An organism's ecological niche depends not only on where it lives, but also on its function in the community. To understand an organism's niche, we must know its sources of energy and nutrition (its role in the food chain), its metabolism and growth rates, its effect on other organisms with which it comes into contact, the seasons in which it is active, and how much it can modify its environment.

Scientists believe that, in the long run, only one species can occupy a specific niche or play a specific role in the ecological community; if two species compete for one role, one will eventually be driven out. This does not mean that very similar species, among birds for example, can not occupy very similar niches. Interestingly enough, scientists have found that different species occupy nearly identical niches in ecological communities in different parts of the world. These species, which have developed to perform certain functions in the ecological community they belong to, are called "ecological equivalents."

Hopefully these general ecologic concepts will help you understand what the organisms you observe in the outdoors are doing, why they live where they do, and how they interact with other organisms around them. These ideas should help all of us realize that the lives of the plants and animals we see have a purpose. If we recognize the environmental conditions that promote stability and productivity for different species, then we can protect or use natural resources in a way which will minimize Man's adverse effects on ecological inter-relationships.

Animals

Do you hear any animal sounds? A singing bird, a croaking frog, the rustling of branches all tell you when animals are near.

What are the sounds that you hear? What animals do you think are making these sounds?

Can you find any traces of animals? Look for tracks, droppings, nests, bits of hair, bones, and burrows.

Do you see any animals? What are they?

Use a poem, a cinquain, sketch, or a story to tell about one or more animals you have seen or suspect to be living in this place.

List all the animals and animal traces you find in this place.

Findings

Animals seen (name or sketch)	Description

Animals heard (name or sketch)	Description of sound

Animal traces seen (describe or sketch)	Animal you think left trace

Of the animals you have seen or have found evidence of, choose one and try to discover all you can about it. Put yourself in the animal's role. What would you eat and where would you find your food? Is there a danger that another animal might eat you? What animal would that be? Where would you go for water? Where would

you take shelter from danger? How would the changing seasons affect your life? Write a story about how you would feel as that animal living here.

To locate the homes of animals here, look high and low. Almost every place in Nature provides a house for some animal. Be careful not to disturb these homes when you look. Make a list of the homes you find here and their inhabitants.

Kind of home	Inhabitants	Reason they choose this home

Can more than one kind of animal live in the same home? If so, does one animal help the other, do they both help each other, do they compete, or what? Describe some of these inter-relationships which you can see or have learned about in the past.

Do you know some animals that defend their homes, or the territory around their homes? If so, describe these animals, their enemies, and how they protect themselves.

Do all animals spend their whole life in one home? If you know some animals that move during their life, think about the distance they travel to find a new home, and why they move around as they do.

Think about the seasons in this place. Do weather changes during the year affect the animals? How do some of the animals here protect themselves from bad weather, or take advantage of good weather?

How do you think Nature helps the animals here to detect danger?

Do you think Nature helps the animals here to hide from danger? How does it help?

Think about the foods animals eat. Do some animals have to go farther than others to get food? Describe some examples of food gathering that you know.

Think about factors that affect the amount of food available to animals. Does the number of animals in this area affect the food supply? How?

What effects does climate have on the food supply?

What effects do Man's activities have on the food supply?

Do most of the animals you know eat more than one kind of food? Could this help them survive if the supply of some foods is short?

Now that you have investigated some of the basic needs of animals, do you think this place can support a large number of different kinds of animals? Why or why not?

What do you think is the biggest animal living here? The smallest?

Do you think the same animals are living here now that lived here 10,000 years ago? 1,000 years ago? 100 years ago?

Have some of the animals which no longer live here become extinct? _____
If you think so, list some animals you have heard of which are now extinct.

Why do you think animals become extinct?

Possible reason because of Nature	Because of Man

Do you think the animals that live here now will be living here in 1,000 years? In 100 years?

If you think some of them will be gone, why will this happen? Try to think of several reasons.

Some of today's animals are in danger of extinction. Do you know about any of these rare or endangered species? Do any of them live in your area or in your state?

You can find out about these endangered species by contacting your state game or fish commission or the Bureau of Sport Fisheries and Wildlife in the U.S. Department of the Interior. (The addresses for this and other conservation organizations appear in the Appendixes on Page 126.)

In what ways are animals important to you? In what ways are they dangerous or destructive?

Important to Man	Danger to Man

Use a poem, a sketch, or a story to show what it is about animals, or a particular animal, which interests you most of all.

Try to visit a zoo or park where animals are kept. Make comparisons between the ways animals live and behave in captivity and in the wild. What do you think would happen to zoo animals if they were suddenly released into a natural area?

What do you think would happen if an animal from the wild were transported from one natural habitat to another similar one?

If your class is interested in the protection and management of wildlife, perhaps you can organize a simulation game to investigate a problem such as the following:

The Problem:

> A rancher raises a large number of cattle for a living and grazes these cattle on a large acreage of land. He discovers that some wolves have killed several of his cattle in a faraway pasture. In his state, predators such as wolves are not protected by law. Therefore, the rancher tells his workers to shoot any wolves they see on his property. Some of the other ranchers agree with him that these predators must be controlled, but the rancher is criticized by other people in town, especially the members of several conservation organizations. Many local hunters become involved in the argument, too. An official of the state fish and game commission is asked for his opinion. Several local newspaper reporters want to write articles describing the facts of the situation.

The Players:

1. The rancher: This rancher makes a living for himself and his family by raising and selling beef cattle. To raise good cattle he must make large investments in buildings, equipment, cattle feed, and pasture improvements. He must run a very efficient business each year to make a living. The rancher does not want to kill wolves needlessly, but the loss of even a few cattle is a serious business loss.

2. Other ranchers: They too, depend on cattle-raising to earn their living. They would be unhappy if the law prohibited them from killing wolves and other predators which endanger their cattle in the future. They do not want non-ranchers interfering with a practice which takes place on private property.

3. State fish and game commission officials: These officials work for the state government. The state legislature has been discussing a law to protect certain predators, but so far no law has been passed. These officials have talked a lot in the past with ranchers, conservation groups, and hunters about the predator problem. They believe that predators are part of the ecological balance of Nature, but they recognize the ranchers' problem too.

4. Conservationists: Several people in the community belong to state and national conservation organizations. They believe that the shooting of many wild animals should be forbidden. Some of them are specifically concerned about protecting wild animals that are sought only for their fur pelts and not for food. They are very concerned about protecting the ecological balance of Nature.

5. Local hunters: These people may or may not share the ranchers' reasons, but they agree that predators should not be protected by law. The hunters want to be free to hunt all wildlife including predators. They believe hunting fits in with the natural life and death cycle of the ecological community.

6. Newspaper reporters: The reporters know that there are facts and opinions behind both sides of this controversy over predators. The public is concerned about the issue and, because passage of a state law to protect predators is possible, they want to become better informed. It is the reporter's job to present the facts about the issue as clearly and accurately as possible for the community.

Procedure:

Divide the class into the various groups. Each group should meet and discuss the most important points they will present to the newspaper reporters. Their ideas should be based upon some research into the problem, not just personal opinion. Each group should elect a spokesman to present its ideas to the newspaper reporters at an interview. After listening to the representatives, the reporters should try and summarize the arguments, as they would to prepare a newspaper article. Your class may wish to invite an employee from the game and fish commission or a resource management agency to meet with you and discuss your ideas.

Conclusions:

What reasons in the predator controversy did your class think were the best? Why?

What is your own opinion about the predator controversy described above?

Now that you have enjoyed many different parts of the environment and learned about them, try putting these parts together into one big picture. Think about one of the important natural areas in or near your town.

Do all the parts work together to create a pleasant, healthy environment? If some parts of the environment could be improved, what should be done?

Take another look at the Web of Life on Page 75. The animals depend on plants, sunshine, air, water, and soil for survival, as you have seen. What things in nature do you depend on?

All over the United States and in the rest of the world, people must have food to survive. Think about the food-getting problems of animals you have discussed. What kinds of problems do some people have in getting enough food?

People in every place need a home or shelter, too. What different kinds of shelter do people need in different parts of the United States? In different parts of the world?

Do people in some places have a difficult time finding the shelter they need? Why?

Do people defend their homes or territory against enemies? Why is it necessary to do this?

In some environments there are conditions the animals there have adapted to. The animals have developed physical features or abilities which help them to survive. Are there conditions in Man's environment that he must adapt to? Name as many as you can.

In what ways is Man able to adapt to his environment?

Are there some conditions in the environment which Man cannot adapt to very well? Name as many as you can.

If some unhealthy conditions exist in your environment, do you need more information about them? What places and people could you go to for this information?

Is there a serious problem in or near your community which needs immediate attention? If so, describe it as well as you can and tell why it is important to you.

What do you think should be done about this problem?

Is it important to get other people and students in your community interested in this problem? How can you get them interested?

Are there people in your community working on this problem? Who are they? (If you do not know, try to find out by reading a newspaper or talking with people who know about the problem.)

What are these people trying to do about the problem?

What could you and your class do to help solve this problem? What could your family do?

Appendixes

Teacher's Page

When we study the inter-relatedness of all living things in the environment, it is easy to see that Man is influenced by his environment, and that he has many effects on it, too. Some of the effects of Man's activities, such as the use of DDT and atom bomb testing, have long-range, worldwide effects; these effects suggest that the whole world has become each man's environment, and that international regulation and cooperation will be necessary to protect and improve the world environment.

As human beings, we need to examine our relationship with our environment now. What environmental needs do we have today? Do you think that these needs can be met without taking more energy and more resources from the ecosystem than we should? If it looks as though Man must take more from the environment then it can spare, what can Man do to reduce the adverse effects he may have on the balance of Nature?

Something else we learn from the environment is that we human beings have needs and require certain living conditions, just as plants and animals do. But Man has been able to adapt himself to a greater range of environmental conditions than most organisms. All the developments of the human mind and technology help him survive extreme temperatures, withstand diseases, communicate over long distances, travel all over the earth, and obtain food and shelter. His adaptations or inventions are complex, they utilize many natural resources, and many of them fulfill Man's wants beyond his basic needs.

At this time we need to determine whether the short-term benefits we want now are as important as some long-term environmental losses we may suffer in the future. Maybe we are paying too high a price for today's comforts. Maybe we need to establish priorities for the treatment and use of natural resources; accomplishing really significant shifts in our resource consumption would require the cooperative effort of all individuals and institutions.

By studying ecological relationships, we can learn a lot about our relationships with other members of the human population, too. Ecological study may help us to realize that all individuals have basic needs for survival, and to think about the things each individual really needs. Since we are all inter-related in the same environment, the way each of us acts affects the lives of others. The way all of us use our skills and use earth's resources influences the kind of environment we will live in. Hopefully environmental education can help people learn more about their relationships with their surroundings, and motivate people to act in a way which promotes harmony between Man and his environment.

There is a balance of relationships among organisms in the environment. Man is definitely a part of the environment; he has "mastered" the environment, or so it seems right now, to such an extent that we tend to think everything in the environment exists for Man's benefit and use. Is the environment important because of its support for Man and his activities, or would the environment on this planet have its own value even if Man were not here? This is a difficult question; no one seems certain that one answer is correct. But what do you think?

VOCABULARY

basic ingredients:	the essentials needed to support life.
cinquain:	a form of poetry usually consisting of five lines which describes how a person feels about a certain subject.
collage:	a picture made from pasting objects or clippings dealing with one subject onto a sheet of paper.
ecology:	the field which deals with the relations between living organisms and their environment.
ecosystem:	the system of ecological relationships present within a given community.
environment:	surroundings.
food chain:	a series or chain of plants and animals which depend on each other for a food supply; for example, algae → shrimp → fish → man.
inversion:	a condition in the atmosphere which occurs when a warm layer of air is trapped between two cooler layers of air.
life support system:	everything needed to maintain life.
mapping:	making maps; locating objects in relation to a known point.
net of interaction:	all living things and how they affect one another.
noise:	unwanted, disagreeable sound or sounds.
ppm:	parts per million; used to describe the amount of available oxygen in water.
pH:	how acid or alkaline water or soil is.
pace:	the distance a person travels with each step he takes.
plane table:	a flat surface on which to draw.
pollution:	discharge of waste materials which causes adverse and unpleasant effects to water, air, animals, land, and people.
population:	all the people living in a certain area; also all the living things in a certain area, such as all the animals in one place.
population density:	number of people per any given area of land.
raw materials:	unprocessed materials as they come directly from the land.
site:	the place where something, such as a town, is located.
urban:	of, in, or comprising a city or town; not necessarily a large town.
Web of Life:	all living things and how they depend upon one another for survival.
zoning:	dividing the land area of a town or city into sections restricted to specific types of use and construction.

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